San Lorenzo River Watershed Conjunctive Use Plan

Prepared for:

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Acronyms and Abbreviations

af	acre-feet
afy	acre-feet per year
ASR	aquifer storage and recovery
CDFG	California Department of Fish and Game (now CDFW)
CDFW	California Department of Fish and Wildlife (formerly CDFG)
cfs	cubic feet per second
ft	feet
gpm	gallons per minute
in-lieu recharge	practice of providing surplus surface water to historical groundwater users, thereby leaving groundwater in storage for later use
MHA	Mount Hermon Association
NMFS	National Marine Fisheries Service
SLRBT	San Lorenzo River at Big Trees (USGS gauging station)
SLVWD	San Lorenzo Valley Water District
SMGB	Santa Margarita Groundwater Basin
sq. mi.	square miles
SVWD	Scotts Valley Water District
USGS	U.S. Geological Survey
WAA	Water Availability Analysis (Exponent 2019)
WY	water year (i.e., October 1 through September 30)

EXECUTIVE SUMMARY

ES.1 Introduction

This *San Lorenzo River Watershed Conjunctive Use Plan* has been developed jointly by the San Lorenzo Valley Water District (SLVWD or District) and County of Santa Cruz (County) to identify opportunities for improving the reliability of the District's surface- and groundwater supplies through conjunctively managing these supplies while also increasing stream baseflows for fish in the San Lorenzo River watershed. Preparation of this plan and related technical investigations was funded through a planning grant awarded to the County by the California Wildlife Conservation Board under its Streamflow Enhancement Program.

The District serves 26,000 customers with water sourced from nine stream diversions on tributaries to the San Lorenzo River, one groundwater spring, and eight groundwater wells within the Santa Margarita Groundwater Basin (SMGB). The District's operations are comprised of three largely independent water systems: (1) the North System located in the San Lorenzo Valley, (2) the South System located in the Scotts Valley area, and (3) the Felton System located in Felton. The neighboring Scotts Valley Water District (SVWD) also relies on groundwater pumped from the SMGB in addition to recycled water. The District's three independent systems lack substantial surface storage infrastructure. Interconnection of these systems therefore has the potential to provide the District with greater flexibility to move water supplies between the systems by utilizing surplus surface water to augment groundwater supplies during winter and spring, and conversely, increasing reliance on groundwater or alternate sources during the low surface seasons of summer and fall, thereby enhancing aquatic habitat quality and quantity in the San Lorenzo River watershed during times when low baseflows limit fish growth and survival.

The plan has been developed concurrently with the Groundwater Sustainability Plan (GSP) being developed by the Santa Margarita Groundwater Agency and the Habitat Conservation Plan (HCP) being developed by the City of Santa Cruz. SLVWD coordinated with both agencies in the process of developing this Conjunctive Use Plan.

ES.2 Objectives

Development of this *San Lorenzo River Watershed Conjunctive Use Plan* consisted of technical evaluations of a wide range of potential actions (scenarios) for the District to consider implementing in an effort to meet the plan goals of increasing water supply reliability and dry season streamflows through conjunctive use. The primary objectives of this plan are:

- Optimizing the conjunctive use of available water resources for water-supply reliability and long-term sustainability;

- Reducing Felton system diversions during low-flow and dry-period conditions and compliance with water rights restrictions;
- Reducing the effect of North system stream diversions and groundwater pumping on dry-period streamflows;
- Reducing groundwater pumping (e.g., by in-lieu recharge) to promote the recovery of groundwater storage and production in the South system and other portions of Scotts Valley.

Technical investigations considered the following means for achieving these objectives:

- Using existing inter-system emergency interties to provide:
  - The Felton service area with excess water produced by the other two service areas at times when Felton system diversions are restricted.
  - The South system and possibly Scotts Valley with excess stream diversions from the Felton and North systems.
  - The North system with excess diversions from the Felton system.
- Using SLVWD's Loch Lomond Reservoir allotment to reduce Felton system diversions, South system groundwater pumping, and North system diversions and groundwater pumping.
- Using excess surface water to supply an aquifer storage and recovery (ASR) project in the North system wellfield.

ES.3 Overview of Technical Assessments

In 2019, SLVWD conducted technical evaluations to analyze a wide range of alternative scenarios for conjunctively managing its surface water and groundwater sources to improve the reliability of its water supplies while also maintaining or enhancing summer dry season flows and habitat quality for steelhead (*Oncorhynchus mykiss*) and coho salmon (*O. kisutch*) in the San Lorenzo River watershed.

In January 2019, a Water Availability Assessment (WAA) was prepared, identifying a wide range of options for conjunctively managing the District's water supply. The WAA presented and evaluated 22 alternative scenarios for optimizing the conjunctive use of current and potential water sources using existing and potential infrastructure.

In November 2019, a Fisheries Resource Considerations report was prepared to evaluate and summarize the expected effects to fisheries resources of the prioritized conjunctive use scenarios from the WAA. The Fisheries Resource Considerations report identified an additional conjunctive use scenario for consideration and recommended a combination of scenarios that, if implemented together over time, would promote watershed-wide improvements to instream flows.

The 2019 studies concluded that increasing the conjunctive use of groundwater and surface water supplies within the San Lorenzo River watershed has the potential to improve water rights compliance, instream flows, and groundwater storage.

ES.4 Selected Conjunctive Use Scenarios

Based on the 2019 studies, SLVWD selected four conjunctive use scenarios to advance to this Conjunctive Use Plan. Two of the conjunctive use scenarios would be implemented in the short-term (within the next five years) under Phase 1 of the conjunctive use plan while the other two scenarios would be implemented in the long-term (greater than five years) under Phase 2.

Scenario 1b – Felton system complies with required bypass only (Phase 1)

SLVWD's water right Permit 20123 for the Felton system includes a bypass flow requirement on Fall Creek as well as a complete restriction on all Felton system diversions under the Permit during low flow conditions in the mainstem San Lorenzo River. Under this scenario, SLVWD would continue to comply with the Fall Creek bypass flow requirement but petition the State Water Resources Control Board to amend Permit 20123 to relieve the District of the San Lorenzo River low flow requirement. Although the Felton system could fully comply with all water right permit requirements with imports from a supplemental source such as Loch Lomond allotment and/or ASR, the fisheries effects evaluation (Podlech 2019) concluded that using those sources for conjunctive use projects such as in-lieu groundwater recharge and/or reductions in summer surface water diversions from North system streams would likely result in streamflow and fisheries benefits that outweigh the benefits achieved through compliance with the San Lorenzo River low-flow diversion thresholds.

Scenario 1f – South System Imports North System Unused Potential Diversions (Phase 1)

Implementation of this project would utilize an existing emergency intertie to transfer an average of 115 acre-feet per year (afy) of unused potential diversions from North system surface water sources to the South system as a substitute for pumping groundwater from the Pasatiempo wells, thereby providing in-lieu recharge of the groundwater aquifer and increasing simulated drought baseflows in eastern watershed tributaries affected by groundwater pumping.

Scenario 2b – South System Imports from Loch Lomond for In-Lieu Recharge (Phase 2)

Implementation of this project would also utilize existing emergency interties to transfer an average of 245 afy of the District's existing unused Loch Lomond reservoir allotment to the South system for in-lieu recharge of the groundwater aquifer and increasing simulated drought baseflows in eastern watershed tributaries affected by groundwater pumping. In addition, 4 afy and 50 afy of Loch Lomond on average would be transferred to the North system and Felton system, respectively, to help meet unmet demand in those systems.

Scenario 3d – North System Operates ASR Project Using North and Felton System Unused Potential Diversions, and Reduces Baseflow Diversions from North System (Phase 2)

Implementation of this project would increase storage in, and yield from, the Olympia wellfield in the North System through operation of a hypothetical ASR project supplied by available surface water in excess of monthly water demand during wet flow season. SLVWD would divert an average of 190 afy and 220 afy of currently unused potential diversions from the North and Felton systems, respectively, for ASR injection and subsequent extraction. Operation of the ASR system would allow SLVWD to reduce North system groundwater pumping by roughly half, thereby improving drought baseflow levels in nearby streams. A portion of simulated summer ASR extraction would be used to offset decreases in summer surface water diversions from SLVWD source streams. Implementation of this scenario would require significant planning and feasibility analysis as well as substantial infrastructure investments (e.g., construction of ASR system) and is therefore only considered conceptually in this conjunctive use plan.

CHAPTER 1
Introduction

1.1 Background

The San Lorenzo Valley Water District (SLVWD or District) and County of Santa Cruz (County) have jointly developed this *San Lorenzo River Watershed Conjunctive Use Plan* to identify opportunities for improving the reliability of surface- and groundwater supplies for the District through conjunctively managing its water supplies while also increasing stream baseflows for fish in the San Lorenzo River watershed. The District serves 26,000 customers with water sourced from nine currently active stream diversions on tributaries to the San Lorenzo River, one groundwater spring, and eight active groundwater wells within the Santa Margarita Groundwater Basin (SMGB). The District's operations are comprised of three largely independent water systems: (1) the North System located in the San Lorenzo Valley, (2) the South System located in the Scotts Valley area, and (3) the Felton System located in Felton (**Figure 1-1**). The neighboring Scotts Valley Water District (SVWD) also relies on groundwater pumped from the SMGB in addition to recycled water. Each system produces water in response to immediate water demand given that these systems lack substantial surface storage infrastructure (Exponent 2019). Interconnection of these independent systems has the potential to provide the District with greater flexibility to move water supplies between the systems by utilizing surplus surface water to augment ground water supplies during winter and spring, and conversely, increasing reliance on groundwater or alternate sources during the low surface seasons of summer and fall, thereby enhancing habitat quality and quantity for steelhead (*Oncorhynchus mykiss*) and coho salmon (*O. kisutch*) populations of the San Lorenzo River watershed during times when low baseflows limit fish growth and survival.

Increasing the conjunctive use of groundwater and surface water supplies within the San Lorenzo River watershed has the potential to address several water-resource issues and opportunities. Increased conjunctive use practices would help address the following issues:

- Under existing water rights, SLVWD's Felton system stream diversions are restricted during defined low-flow periods and are not permitted for use outside the Felton service area.

- State and federal fish and wildlife agencies potentially could impose limitations on the North system's pre-1914 appropriative water rights to divert surface water.

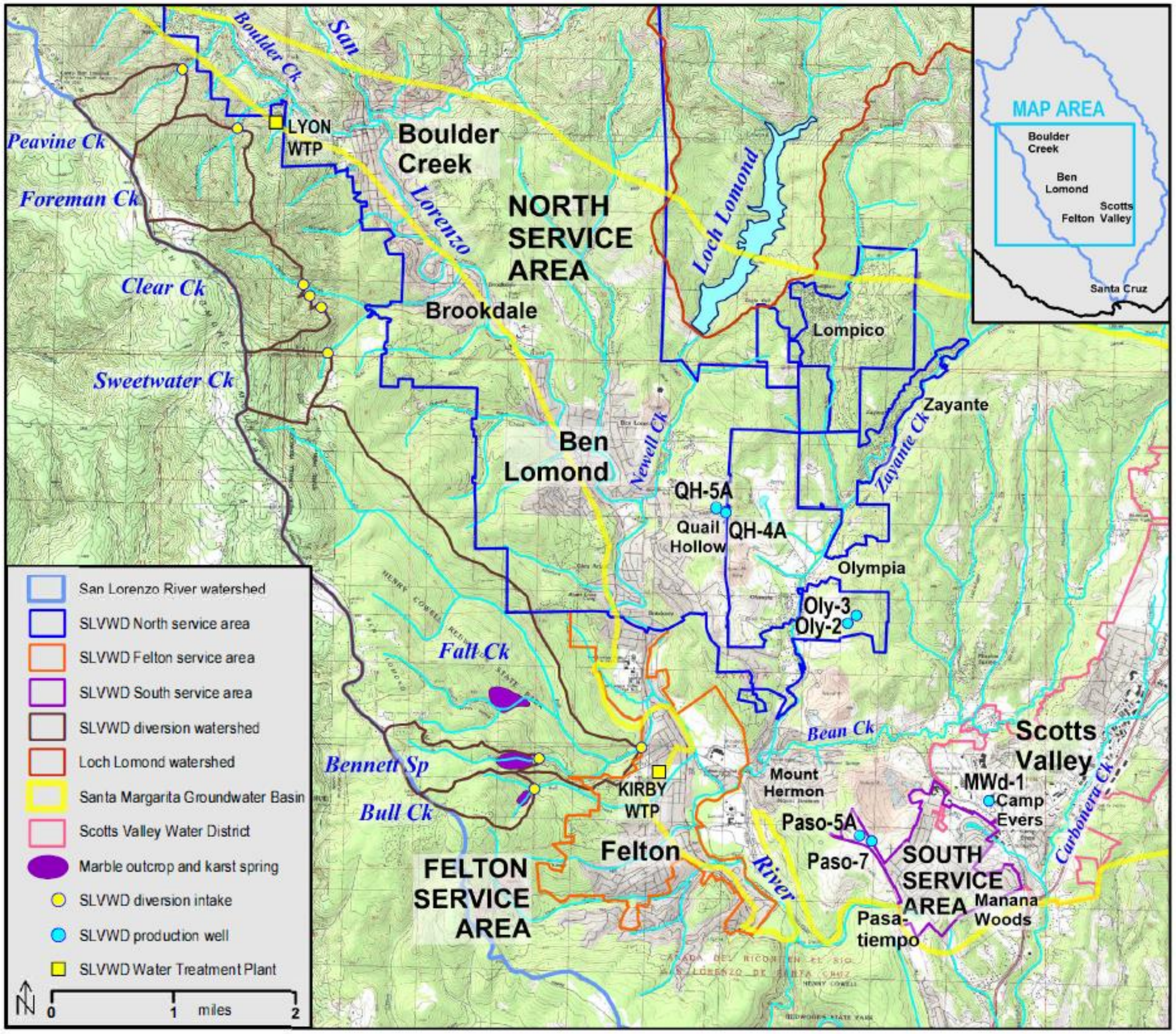


Figure 1-1
SLVWD Service Areas, Diversion Watersheds, Points of Diversion, Treatment Plants, and Production Wells

SOURCE: Exponent (2019)

- Groundwater overdraft in the Scotts Valley area, including in the vicinity of SLVWD's South system, must be addressed in compliance with the 2014 California Sustainable Groundwater Management Act (SGMA), which includes preventing impacts to groundwater dependent ecosystems.

Opportunities that facilitate increased conjunctive use include:

- Since 2014, SLVWD has constructed bi-directional emergency interties between its three systems and between SLVWD and SVWD. Although currently only authorized for emergency use, these interties provide a potential means for transferring water supplies among service areas on a non-emergency basis.

- When exceeding local demand, divertible streamflows within the North and Felton systems have the potential to supply demand in other areas and to augment groundwater recharge.

- SLVWD has an allotment, unused since 1977, for a portion of the water stored by the City of Santa Cruz in Loch Lomond Reservoir, which could be used to increase groundwater storage and/or offset stream diversions.

SLVWD conducted technical evaluations to analyze a wide range of alternative scenarios for conjunctively managing its surface- and groundwater sources to improve the reliability of its water supplies while also increasing stream baseflows in the San Lorenzo River watershed. The studies concluded that increasing the conjunctive use of groundwater and surface water supplies within the San Lorenzo River watershed has the potential to improve water rights compliance, instream flows, and groundwater storage. SLVWD has selected four conjunctive use scenarios (Chapter 2) based on the potential relative magnitude and effects of the various alternatives, cost, feasibility, and expected fisheries benefits. Two of the selected conjunctive use projects are identified for near-term (i.e., within 5 years) implementation under Phase 1 of this plan (see Chapter 3) and the other two scenario projects would be implemented in the long-term (greater than five years) under Phase 2 of this plan (Chapter 4).

1.2 Watershed Overview

The San Lorenzo River drains a 138 square mile (sq. mi.) watershed located in northern Santa Cruz County (**Figure 1-2**). It consists of a 25-mile long mainstem and nine principal tributaries: Branciforte, Carbonera, Zayante, Bean, Fall, Newell, Bear, Boulder, and Kings creeks. Much of the watershed is forested with pockets of urban areas (e.g., Santa Cruz, Scotts Valley, Felton, Ben Lomond, and Boulder Creek) and an increasing proportion of rural residential developments. Paved and unpaved roads occur in stream corridors, providing access to the small mountain communities and towns that occur throughout the San Lorenzo Valley (e.g., Felton, Ben Lomond, Brookdale, Boulder Creek, Lompico, Zayante, and Mt. Hermon).

Elevations in the watershed range from about 3,200 feet at the summit of Castle Rock Peak, down to sea level at the mouth of the river in the City of Santa Cruz. With its headwaters at an elevation of approximately 2,900 feet, the San Lorenzo River drops 2,000 feet in its first three miles. Small, steep tributaries feed the river from the west at Ben Lomond Mountain, while wider, more gently sloping tributaries feed the river from the east and northeast.

Annual rainfall varies between 15 inches to more than 100 inches throughout the watershed, depending upon location and year (SLVWD 2009). Ben Lomond Mountain, source of SLVWD's surface water, averages near the high end of the range. Rainfall averages approximately 46 inches per year in the watershed upstream of Felton, but less than that in the remainder of the watershed. Coastal fog is an important part of the summer climate, creeping into inland valleys at night and in mornings. Average daily temperatures vary throughout the watershed and by season, generally ranging from 30°F to 90°F.

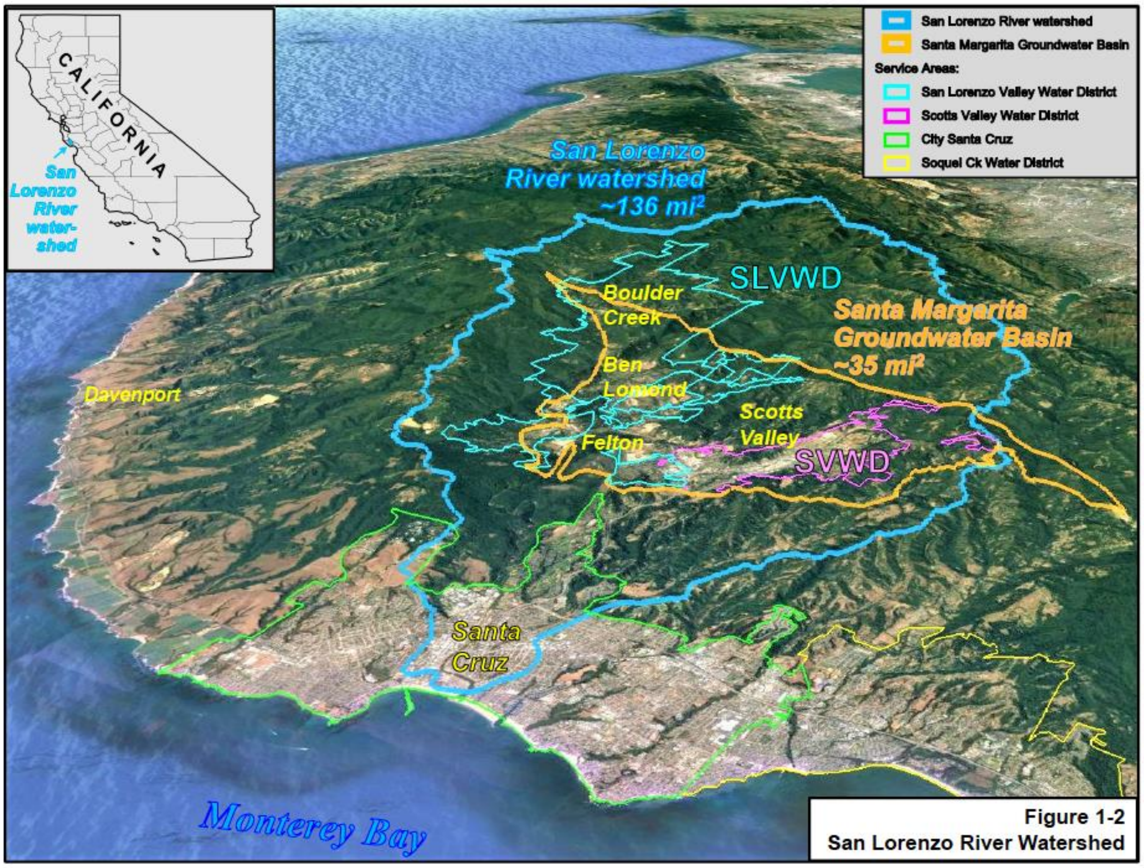


Figure 1-2
San Lorenzo River Watershed

SOURCE: Exponent (2019)

1.3 Existing SLVWD Water Resources

SLVWD serves approximately 22,000 customers with water sourced from nine stream diversions on tributaries to the San Lorenzo River, one groundwater spring, and eight active groundwater wells. The District's operations are comprised of three largely independent water systems (Figure 1-1): (1) the North System located in the San Lorenzo Valley (Boulder Creek, Brookdale, Ben Lomond, Zayante), (2) the South System located in the Scotts Valley area, and (3) the Felton System located in Felton (formerly the Citizens Utilities Company of California Service Area). Interconnection of these independent systems would provide SLVWD greater flexibility to move water supplies between the systems by utilizing surplus surface water to augment groundwater supplies during winter and spring, and conversely, increasing reliance on groundwater sources during the low surface seasons of summer and fall to protect and enhance stream baseflow levels for fisheries resources. The District has already developed some of the infrastructure needed to implement conjunctive use, such as pipeline interties (currently authorized for emergency use only), through a Proposition 50 grant from the California Department of Public Health (CDPH).

1.3.1 Surface Water Resources

North System

The North system is located in the northern portion of the San Lorenzo Valley (Figure 1-1) and serves the unincorporated communities of Boulder Creek, Brookdale, and Ben Lomond. The surface water components of SLVWD's North System consist of diversions located on the eastern slope of Ben Lomond Mountain from Boulder Creek to Brookdale, with multiple diversion boxes that feed into a gravity pipeline (Five-Mile Pipeline, or the much smaller Peavine Pipeline) and ultimately to the Lyon Treatment Plant in Boulder Creek. SLVWD's North System includes surface water diversions on Peavine Creek and Foreman Creek (tributaries to Boulder Creek), Clear Creek (tributary to the mainstem San Lorenzo River), and Sweetwater Creek (tributary to Clear Creek). Historically, SLVWD also diverted approximately 10 acre-feet per year (afy) from Silver Creek, a small drainage tributary to Boulder Creek, but this diversion has been inactive and there are currently no plans to reactivate it (Balance Hydrologics 2019).

SLVWD has pre-1914 appropriative water rights to divert from North System surface water sources including Peavine, Foreman, Clear, and Sweetwater creeks, which generally enable it to supply water from these streams to its North System without restriction. Based on monthly rates of record, Exponent (2019) estimated the maximum capacities, expressed as equivalent continuous monthly rates, of the North system's surface water diversions as follow:

Foreman Creek:	930 gallons per minute (gpm) (2.1 cubic feet per second; cfs)
Peavine Creek:	270 gpm (0.6 cfs)
Clear Creek:	300 gpm (0.7 cfs)
Sweetwater Creek:	260 gpm (0.6 cfs)

However, these maximum rates generally do not occur simultaneously because of limited raw water conveyance and treatment capacities. The combined capacities of the Foreman, Peavine, Clear, and Sweetwater creeks diversions exceed the 1,100-gpm (2.45 cfs) capacity of the trunk raw water line from the Foreman mixing vault to the Lyon Water Treatment Plant (WTP), which also has a design capacity of 1,100 gpm, but a maximum monthly output equivalent to approximately 980 gpm (2.2 cfs).

Based on SLVWD production records and four years (2014-2017) of diversion gaging conducted by Balance Hydrologics[1], the highest average monthly combined diversion rate at the Peavine and Foreman facilities was approximately 2.0 cfs in March and April of 2017, in the midst of a water year characterized by approximately 300 percent of the historic (1937-2017) mean annual discharge for the San Lorenzo River watershed (Balance Hydrologics 2019). During the drought years of 2014 and 2015, the combined mean monthly diversion rates from the Boulder Creek tributaries only exceeded 1.0 cfs on one occasion (December 2015) and were less than 0.25 cfs during summer (July through September) baseflow conditions.

The monthly mean diversion rate from Clear Creek between May 2014 and September 2017 was typically less than 0.25 cfs, and the highest diversion rate was 0.45 cfs (April 2016). July through September diversion rates were typically less than 0.1 cfs. For the Sweetwater Creek diversion, monthly mean diversion rates were typically less than 0.2 cfs, and the highest rate was 0.34 cfs (January 2016). Water is rarely diverted at the Sweetwater diversion during the July-September baseflow season. SLVWD typically operates the Clear Creek system to bypass a minimum of 35 gpm (0.08 cfs).

Felton System

The Felton system is located in the central portion of the San Lorenzo Valley (Figure 1-1). The Felton service area was acquired by SLVWD from California American Water in September 2008 and includes the town of Felton and adjacent unincorporated areas. SLVWD's Felton system relies entirely on surface water diversions from Fall and Bull creeks, tributaries to the middle San Lorenzo River, and Bennett Spring and Creek, tributary to Fall Creek. SLVWD diverts from Fall Creek via a diversion gallery installed in the stream bed which is backwatered by a v-notch weir fitted with a fish ladder. Water is pumped by pipeline to the nearby Kirby treatment plant in Felton. The Bull and Bennett Creek intakes are primarily spring-fed diversions that are combined into a single diversion line to the Kirby treatment plant. The Felton System diversions are operated under permitted and licensed appropriative rights limited to a combined total diversion rate of 1.7 cubic feet per second (cfs) and a total annual diversion volume of 1,059 afy. The permitted right includes bypass flow requirements on Fall Creek, defined separately for dry and non-dry years, defined in terms of the gauged flow of the San Lorenzo River at Big Trees (SLRBT) U.S. Geologic Service (USGS) gage. The water rights permit defines Fall Creek bypass flow requirements as follow:

Dry years:	0.75 cfs during November 1–March 31
	0.50 cfs during April 1–October 31
Other years:	1.5 cfs during November 1–Mar 31
	1.0 cfs during April 1–October 31

[1] Balance Hydrologics has prepared four separate annual monitoring reports for water years 2014 through 2017 (Balance Hydrologics 2015, 2018a, 2018b, and 2019). References to streamflow and diversion data presented herein frequently span all four monitoring years and associated annual reports, and are therefore generally attributed to "Balance Hydrologics" without reference to specific report publication years.

For the purpose of the Fall Creek bypass flow requirements, dry years are defined as water years in which cumulative flows at SLRBT are less than the following amounts:

October:	< 500 acre-feet (af)
October–November:	< 1,500 af
October–December:	< 5,000 af
October–January:	< 12,500 af
October–February:	< 26,500 af

Furthermore, diversions are not allowed under the permit from any Felton source during low-flow conditions in the San Lorenzo River, defined as the following flow rates at the SLRBT gage:

September:	10 cfs
October:	25 cfs
November–May:	20 cfs

Based on maximum monthly rates of record, Exponent (2019) estimated the maximum capacities, expressed as equivalent continuous monthly rates, of the Felton system's surface water diversions as follow:

Fall Creek:	280 gpm (0.6 cfs)
Bennett Spring (to WTP):	200 gpm (0.45 cfs)
Bennett Spring (2-inch line):	13 gpm (0.03 cfs)
Bull Creek:	225 gpm (0.5 cfs)

However, as is the case in the North system, the Felton system is currently limited by treatment capacities. All Felton system diversions are processed at the Kirby water treatment plant, which has a design capacity of 700 gpm (1.6 cfs) but typically operates at half capacity using only one of two units (Exponent 2019). The maximum continuous monthly production rate of the Kirby WTP is approximately 425 gpm (1.0 cfs). During water years (WY)[2] 2014-2017, mean monthly diversions at the Fall Creek diversion never exceeded 0.5 cfs. Unlike North system diversions, Fall Creek diversions do not vary greatly from season to season. Based on SLVWD production records, diversions from Bennett Spring rarely reach 0.4 cfs.

Based on Balance Hydrologics monitoring, the monthly mean diversion rate from Bull Creek during WYs 2015-2017, was typically less than 0.25 cfs, and the highest documented monthly diversion rate was 0.32 cfs (February 2016). July through September diversions were typically around 0.1 cfs.

[2] In California, water years typically extend from October 1 through September 30 of the following calendar year.

Loch Lomond Reservoir

In 1958, SLVWD sold 2,500 acres of land encompassing a portion of the San Lorenzo River tributary watershed of Newell Creek to the City of Santa Cruz (City) with the agreement that SLVWD would be entitled to purchase 12.5 percent of the annual safe yield from a reservoir planned by the city. The City created Loch Lomond Reservoir with the completion of Newell Creek Dam in 1960.

Loch Lomond Reservoir has a drainage area of 8.3 sq. mi. and a reservoir capacity of approximately 9,000 af. The City's Newell Creek appropriative water right license authorizes a maximum of 5,600 afy of water to be diverted to storage between September 1 and July 1. The maximum amount of withdrawal of water from storage in the Loch Lomond Reservoir under this license is limited to 3,200 afy. The City is also authorized to divert water from the San Lorenzo River at the Felton Diversion Facility under two separate water right permits that allow for a combined maximum diversion of 3,000 afy to storage at Loch Lomond Reservoir between September 1 and June 1 under one permit and October 1 and June 1 under the other permit (City of Santa Cruz 2018). Water diverted at Felton is transported by a large diameter pipeline and a series of pump stations to Loch Lomond Reservoir for storage. Water from both the Felton Diversion and Newell Creek are stored in Loch Lomond Reservoir, and the total maximum amount of water that is authorized to be held in the reservoir is 8,624 afy (City of Santa Cruz 2018).

SLVWD began receiving a portion of the reservoir yield after the dam was completed, although records are only available for 1976–77, when it received 353 af. SLVWD has not received any water from Loch Lomond since 1977. Since implementation of the Surface Water Treatment Rule, SLVWD has not had the means to treat diversions from Loch Lomond. In 2010, the City and SLVWD discussed an option that would allow SLVWD to purchase up to 313 afy of treated City of Santa Cruz water. During the discussion, the City indicated that the treated water allocation would be reduced or interruptible during declared water-shortage emergencies. Interruptible service of the allotment was unacceptable to SLVWD and no agreement was reached.

Since 2001, the City has been developing a Habitat Conservation Plan (HCP) with the National Marine Fisheries Service (NMFS) and California Department of Fish and Wildlife (CDFW) for federal and California Endangered Species Act compliance for water supply operations that may affect steelhead and coho salmon (City of Santa Cruz 2018). As part of the HCP process, the City, NMFS, and CDFW have developed minimum flow requirements for streams affected by the City's diversions, including Newell Creek and the San Lorenzo River at Felton, the two sources of Loch Lomond water. Moreover, the City has committed to implementing these minimum flows as part of its water rights modification process regardless of the final outcome of the HCP process (City of Santa Cruz 2018). Although SLVWD has the right to a 313 afy allotment of stored Loch Lomond water, this water is diverted by the City pursuant to applicable bypass requirements at Newell Dam and the Felton Diversion for the protection of steelhead and coho salmon. SLVWD therefore does not have any bypass flow requirements associated with its Loch Lomond allotment.

1.3.2 Groundwater Resources

SLVWD draws approximately 45 percent of its average annual water supply from three loosely defined groundwater subareas of the SMGB (Exponent 2019). Wells in the Quail Hollow and Olympia areas are part of SLVWD's North System, and the Pasatiempo area wells are part of SLVWD's South System, which is supplied solely by groundwater. The Quail Hollow and Olympia wells draw solely from separate portions of the Santa Margarita Sandstone aquifer, whereas the Pasatiempo wells draw predominantly from the underlying Lompico Sandstone aquifer (Exponent 2019). In addition to SLVWD, the Scotts Valley Water District (SVWD) and Mt. Hermon Association (MHA) also operate groundwater wells within the SMBG.

Since 2000, SLVWD's annual North system groundwater production has averaged approximately 280 afy from the Quail Hollow wells and 400 afy from the Olympia wells, but their use fluctuates substantially in response to annual and seasonal availability of divertible streamflows. Since the 1970s, the Quail Hollow wells have experienced little if any long-term net decline in groundwater levels, whereas water levels in the Olympia wells have exhibited a slight long-term downward trend since the 1980s, suggesting that higher rates of extraction may be unsustainable without augmenting recharge (Exponent 2019).

Annual production of the South system's Pasatiempo wells has averaged 380 afy since 2000. As the sole water supply for the South system, production from SLVWD's Pasatiempo wells fluctuates with seasonal water demand. Overall Pasatiempo groundwater levels have declined by as much as 200 feet (ft) since the early 1980s, consistent with long-term groundwater level declines throughout much of the general Scotts Valley area (Exponent 2019). Although well yields have been sufficiently reliable, replenishment of the aquifer through reduced pumping and possibly managed aquifer recharge is an expected outcome of future groundwater management under SGMA.

1.3.3 Interties

Four emergency interties were constructed in 2014 to provide SLVWD with the ability to transfer water between its three systems as well as between its own systems and those of SVWD and MHA. However, the only currently permitted use of these interties is to enable the transfer of water in case of an emergency such as mechanical or structural failure of facilities, aquifer contamination, bioterrorism, or natural disaster (e.g., earthquake, landslide, forest fire, large structural fire) (SLVWD 2013). Use of these interties by SLVWD for non-emergency operations requires additional review under the California Environmental Quality Act (CEQA). To maximize the non-emergency utility of the interties, SLVWD may need to petition the State Water Resources Control Board (State Water Board) to amend its existing water rights to add areas receiving water transfers to the authorized Places of Use (POU) and potentially modify other aspects of the rights.

Two of the existing emergency interties allow for transfers among SLVWD's three water systems. Intertie #3 (IT3) connects the North and South system and has a design capacity of 700 gpm, while Intertie #6 (IT6) connects the North and Felton systems and has a design capacity of 350 gpm. There is no direct intertie between the Felton and South systems and transfers between these two systems would therefore occur via IT3 and IT6. These two interties are proposed to be utilized for conjunctive use under this plan.

Additionally, two inter-District emergency interties are available. Intertie #2 (350 gpm capacity) connects SLVWD's South system to SVWD's distribution system, and Intertie #4 (150 gpm capacity) tees off of the IT3 pump station and connects SLVWD's North system to MHA's distribution system.

1.4 Fisheries Resources

The San Lorenzo River and its estuary are inhabited by at least 25 different species of native fish (DWA 2009). These include salmonids such as central California coast (CCC) steelhead (*Oncorhynchus mykiss*) and, historically, CCC coho salmon (*O. kisutch*). These two species are anadromous fish that occupy freshwater streams and rivers as juveniles, migrate to the ocean to grow and mature, and then return to spawn in their natal freshwater streams. Both species are afforded protections under the federal Endangered Species Act. The San Lorenzo River watershed is considered essential to the recovery of steelhead and coho salmon on the Central Coast. The *Final Coastal Multispecies Recovery Plan* (NMFS 2016a) rates summer baseflow conditions in the San Lorenzo River watershed as "poor" for juvenile steelhead rearing and considers water diversions and impoundments a "very high" threat to the population. While a wide variety of aquatic and riparian species are dependent on seasonably suitable streamflow levels, the enhancement of steelhead and coho salmon summer baseflow habitat conditions is a primary ecological objective of this conjunctive use plan. A brief overview of general habitat conditions in the San Lorenzo River watershed is provided below, followed by specific discussions of existing fisheries resources in SLVWD surface water supply drainages and streams potentially affected by groundwater extractions. A detailed evaluation of the existing fisheries resources and potential effects of relevant conjunctive use scenarios are discussed in the *Fisheries Resource Considerations for the San Lorenzo River Watershed Conjunctive Use Plan* report (Podlech 2019).

SLVWD does not operate water diversion facilities directly on the mainstem San Lorenzo River, but all its existing surface and groundwater supply facilities are located within drainages tributary to the mainstem. Past and current salmonid population trends in the San Lorenzo River are the subject of an extensive long-term monitoring program and have been summarized in numerous reports (e.g., Alley et al. 2004; DWA 2009; DWA 2017) and an online database (County of Santa Cruz 2019). The following overview of existing salmonid habitat conditions and utilization in the mainstem San Lorenzo River is based largely on the thorough discussion provided by D.W. Alley & Associates (DWA 2009) in SLVWD's *Watershed Management Plan* (SLVWD 2009) and the *San Lorenzo River Salmonid Enhancement Plan* (Alley et al. 2004).

1.4.1 Mainstem San Lorenzo River

The upper San Lorenzo River mainstem (i.e., upstream of the Boulder Creek confluence) is characterized by relatively low but cool spring and summer baseflow. Juvenile steelhead growth is generally slow in this well-shaded reach, but relatively high densities of yearlings are thought to contribute a significant portion of adult steelhead returns to the watershed. Immediately upstream of Boulder Creek, the mainstem river channel has a low gradient, steep canyon walls with tall redwoods, and is dominated by long, sediment-laden pools separated by short, shallow riffles. As stream gradient increases further upstream, pools become shorter and habitat variety increases. According to DWA (2009), limiting factors to salmonids in the upper mainstem include low spring and summer streamflow and sedimentation from erosion.

The middle mainstem extends from the Boulder Creek confluence downstream to the Zayante Creek confluence. This reach has higher annual streamflow than the upper mainstem and a wider, more open canyon. Water temperatures are warmer in the middle mainstem than in the upper watershed, and juvenile steelhead tend to occupy fastwater habitat at riffles, runs and heads of pools where food (aquatic insect) production is higher. The majority of the middle mainstem is dominated by long, deep pools containing lower food supplies. Spawning habitat availability is considered limited and juvenile steelhead densities are generally low (DWA 2017). All of SLVWD's surface water source streams are tributaries to the middle mainstem.

The lower mainstem San Lorenzo River below the confluence of Zayante Creek has much greater spring and summer baseflow than upstream reaches, providing higher food availability even during summer baseflow conditions. Based on limited scale analyses, steelhead growth rates in this reach appear to be high enough to allow many juveniles to reach smolt size after one growing season. The lower mainstem has been estimated to be a major contributor to adult returns. Spawning habitat is poor due to high sand content, and most juveniles rearing in this reach likely originate in the upstream tributaries.

The San Lorenzo River estuary is located in the center of the City of Santa Cruz, discharging to the Monterey Bay at Main Beach and the Santa Cruz Beach Boardwalk. The historic San Lorenzo River lagoon surface area has been reduced by over 80% as a result of road and railroad crossings, extensive floodplain development, and flood control levee construction and maintenance, thereby dramatically simplifying the morphologic complexity of the lagoon (2NDNATURE 2006). The necessity of flood control has eliminated the adjacent low-lying marsh habitat that would typically be inundated during winter runoff and summer lagoon conditions. The lagoon area downstream of Riverside Drive is extremely exposed, devoid of any vegetation and its substrate is homogenous beach sand. Annual vegetation management in the active channel is conducted each fall to maintain flood capacity. Nevertheless, the San Lorenzo River lagoon supports seasonal juvenile steelhead rearing as well as a population of tidewater gobies (*Eucyclogobius newberryi*), a federal endangered species. Sandbar-formed lagoons such as the San Lorenzo River lagoon may provide highly productive rearing habitat in which juvenile steelhead grow fast enough during their first year of lagoon rearing to migrate to the ocean, and most enter the ocean at a larger size than the same year-class of fish rearing in freshwater habitats of the stream system (Bond et al. 2008). Larger juvenile size greatly improves survival to maturity in the ocean, and lagoon-reared fish may therefore represent a large majority of the returning adult spawning population in a watershed (Bond et al. 2008). Juvenile steelhead population estimates for the San Lorenzo River lagoon vary seasonally and annually, but high growth rates are regularly documented (e.g., HES 2017).

1.4.2 SLVWD Source Streams

North System

The North system's Peavine Creek and Foreman Creek diversions are located in the steep terrain typical of the eastern slopes of Ben Lomond Mountain. No information regarding the fisheries resources of Peavine Creek appear to be available. Resident rainbow trout (the non-anadromous form of *O. mykiss*) or steelhead were documented in Foreman Creek in a 1959 California Department of Fish and Game (CDFG, now the California Department of Fish and Wildlife [CDFW]) stream survey, but no recent fish survey data appear to be available. NMFS (2016b) rates the lowermost reaches of these two streams as having a low to moderate potential to support juvenile steelhead as a function of the geomorphologic and hydrologic characteristics of the landscape, but a 12-ft vertical drop on Peavine Creek (Balance Hydrologics 2018a) and "channel steepness and/or lack of suitable habitat" in Foreman Creek (County of Santa Cruz 2004) likely preclude significant steelhead and coho salmon utilization of these two tributaries to Boulder Creek. Based on available information, Peavine Creek and Foreman Creek are not considered to have direct habitat value for anadromous salmonids for the purpose of this conjunctive use plan (Podlech 2019).

Boulder Creek is a well-documented steelhead stream. SLWVD does not operate a water diversion facility on Boulder Creek, but since Peavine and Foreman Creeks are tributaries to Boulder Creek, SLVWD's diversions from these two subbasins have the potential to affect Boulder Creek streamflows and fish habitat. Boulder Creek is the uppermost tributary to the middle mainstem San Lorenzo River. DWA (2009) describe Boulder Creek downstream of the Hare Creek confluence as flowing through a heavily shaded canyon with steep, near-vertical walls and a streambed dominated by large granitic cobbles and boulders in turbulent riffles and runs. Relatively deep pools are present but contain virtually no instream fish refuge except from depth and large, unembedded boulders. High winter water velocities within the confined channel tend to wash out large wood and likely also flush out overwintering juvenile steelhead more easily than in other tributaries. Spawning-sized gravels and small cobbles are limited, and steep boulder riffles may impede adult passage at lower flows. Summer water temperatures in Boulder Creek are among the coolest in the San Lorenzo River watershed. Based on available monitoring data for WYs 2014-2017, DWA (2018a) concluded that SLVWD's water diversions appeared unlikely to result in adverse temperature impacts to steelhead in Boulder Creek. Available juvenile steelhead population monitoring data from 1997 through 2018 (County of Santa Cruz 2019) indicate that average total densities of juvenile steelhead in Boulder Creek upstream and downstream of the Peavine and Foreman creek confluences have been fairly similar. Considering the temporal variability in site-specific habitat conditions (County of Santa Cruz 2019) and the large standard deviations of the available population estimates, however, it is difficult to correlate variations in population densities to the effects of water diversions. Juvenile steelhead growth is relatively slow in Boulder Creek and low spring and summer baseflows may limit steelhead populations (DWA 2009). Although SLVWD summer diversions from Peavine Creek and Foreman Creek are fairly small, their combined effects reduce Boulder Creek baseflows by over 25 percent and likely exacerbated already critically low and presumably stressful streamflow conditions for juvenile salmonids and other native fish in Boulder Creek (Podlech 2019).

The North system's Clear Creek and Sweetwater Creek diversions are also located within the steep eastern slopes of Ben Lomond Mountain. In 1957, Clear Creek was described as unimportant for steelhead because a permanent bedrock barrier at the mouth precluded upstream migration of adult spawners (Titus et al. 2010). Occasional observations of resident rainbow trout have been reported, but a county-wide stream crossing inventory and fish passage evaluation report ranks Clear Creek a low priority stream for fish passage enhancement, in part due to its "limited length of poor-quality habitat" (Ross Taylor & Associates 2004). Based on the available information, Clear Creek (including the Sweetwater Creek tributary) was considered to have limited anadromous salmonid value for the purpose of this conjunctive use plan (Podlech 2019).

Based on synoptic streamflow measurements conducted by Balance Hydrologics, the combined Clear Creek and Sweetwater Creek diversions typically account for a reduction of less than approximately 9 percent of middle mainstem San Lorenzo River flows, with the greatest relative reductions occurring during the summer baseflow period. Water temperature monitoring conducted by DWA (2018a) has shown Clear Creek inflows to cool the San Lorenzo River to a small degree.

Felton System

Fall Creek is a well-documented steelhead stream and is known to have supported coho salmon in the past. As such, SLVWD's diversion on Fall Creek has the potential to affect salmonids in Fall Creek as well as in the San Lorenzo River downstream of Fall Creek. SLVWD's Bennet Spring diversions are located upstream of the limit of anadromy, but diversions may also affect Fall Creek and San Lorenzo River fisheries resources. Based on a summary description by DWA (2009), Fall Creek is one of the most shaded and coolest tributaries in the San Lorenzo River watershed. Even though much of the creek is within Henry Cowell State Park, it is subject to large sediment inputs from steep hillslopes prone to landslides. The landscape is apparently still recovering from past clear-cut logging and limekiln operations. Stream gradient is moderate to steep and the channel is dominated by shallow, fast riffles with relatively few pools. Summer water temperatures have been documented to be suitable for juvenile steelhead and coho salmon[3] rearing upstream and downstream of SLVWD's diversion facility. SLVWD's summer Fall Creek diversions are operated in accordance with its water right summer bypass flow requirements of 1 cfs in normal water years and 0.5 cfs in dry years[4] (Section 1.3.1). Although the diversions have relatively minor effects on summer Fall Creek baseflows in normal (e.g., WY 2016) and wet (e.g., WY 2017) years, the diversions may reduce Fall Creek flows by up to 50 percent (e.g., Balance Hydrologics 2018a) during drought years (e.g., 2014 and 2015). Nevertheless, DWA (2018b) note that even during those extreme conditions, juvenile steelhead were documented

[3] The conservative coho salmon temperature threshold applied by DWA (2018a) has, on occasion, been exceeded by less than 0.3° Celsius downstream of the Fall Creek diversion. Due to the minor level of exceedance and short duration of these occurrences, as well as the documented tolerance of coho salmon to somewhat higher water temperatures, Fall Creek water temperatures are generally considered suitable for coho salmon.

[4] SLVWD's diversions may have been out of compliance with the Fall Creek bypass flow requirement in August and September 2015 (see Figure 2-9 in Balance Hydrologics 2018a) during severe drought conditions. It should be noted, however, that significant weir leakage was subsequently observed in summer 2018 during fish ladder maintenance, indicating that the v-notch weir in use in WY 2015 likely underestimated flows bypassing the diversion.

rearing successfully downstream of the diversion under the cool water conditions typical for Fall Creek. Based on available streamflow, physical habitat, water temperature, and fish density data, SLVWD's Fall Creek diversions do not appear to have discernable adverse effects on the fisheries resources of this tributary stream, although diversions during severe drought conditions likely exacerbate already stressful conditions (Podlech 2019).

During normal and above-normal water years, SLVWD's Fall Creek diversions are unlikely to have discernable effects on San Lorenzo River mainstem fisheries resources due to the minor relative contributions of Fall Creek flows to the mainstem San Lorenzo River. However, the relative contributions from Fall Creek to the mainstem are much higher during prolonged drought conditions due to the tributary's karst geology providing more persistent (multi-year) groundwater outflows (Balance Hydrologics 2018b). During these extreme low flow conditions, Fall Creek diversions account for up to 10 percent of potential loss to mainstem flows. While even impaired Fall Creek inflows help to improve mainstem salmonid habitat quality (e.g., reduced water temperatures) during severe drought conditions, this relative loss of inflow may exacerbate already stressful conditions in the mainstem San Lorenzo River (Podlech 2019).

SLVWD operates two water intakes on Bull Creek, a small tributary to the middle mainstem San Lorenzo River in Felton. A 2014 fishery assessment of Bull Creek concluded that the Bull Creek drainage provides very limited, poor quality habitat for a small, presumably resident rainbow trout population, and that these conditions "would not likely improve with higher baseflow due to very poor pool development" (DWA 2014). A 900-foot culvert system near its confluence with the San Lorenzo River was deemed to effectively prohibit or severely limit passage for adult steelhead into Bull Creek (Kittleson 2017). Bull Creek is not considered to have anadromous salmonid value for the purpose of this conjunctive use plan, but Kittleson (2017) notes that Bull Creek should be managed to protect or enhance habitat for the existing resident rainbow trout population. SLVWD diversions on Bull Creek are estimated to reduce mainstem San Lorenzo River flows by less than 5 percent during the baseflow season (Podlech 2019). Although Bull Creek summer water temperatures are low, its minor flow contribution does not appear to benefit mainstem water temperatures.

1.4.3 SLVWD Groundwater Production

Wells operated by SLVWD do not draw directly from alluvial aquifers and therefore do not induce streamflow infiltration because area groundwater levels are generally higher than the elevation of the gaining streams that dissect or bound the groundwater subareas (Exponent 2019). As such, SLVWD's wells may intercept groundwater flowing *toward* springs and streams, but generally do not draw water directly *from* streams (Exponent 2019). The streams assumed to be indirectly affected by SLVWD's groundwater production are primarily Bean and Zayante creeks, and to a lesser extent Newell Creek and the mainstem San Lorenzo River.

Zayante Creek is a major eastern tributary to the San Lorenzo River in Felton and the confluence marks the dividing line between the middle and lower San Lorenzo River, as defined in Alley et al. (2004). Based on a DWA (2009) synopsis of salmonid habitat conditions, Zayante Creek and its tributary Bean Creek (discussed below) are significant contributors to the juvenile steelhead population and adult index of the San Lorenzo River watershed. Lower Zayante Creek, downstream of the Bean Creek confluence, receives heavy sediment inputs from Bean Creek, but supports relatively high growth rates for juvenile steelhead in wetter years with higher spring and summer baseflow. Juvenile densities are typically low. Between the Bean Creek confluence and the Lompico Creek[5] confluence, long pools dominate the stream. Stream shading is moderate and instream wood and overhanging vegetation provide good cover. Upstream of Lompico Creek, stream gradient increases and step-run habitat units become more abundant. Large yearling steelhead are abundant in pools. Despite higher annual streamflows than other San Lorenzo River tributaries, low summer streamflow and sedimentation are considered the primary factors limiting fish habitat in Zayante Creek (Alley et al. 2004).

Bean Creek is a significant tributary to Zayante Creek. Based on the summary description of DWA (2009), the lower reaches of Bean Creek near Mount Hermon are prone to heavy fine sediment loading from landslides and recreational use has degraded summer habitat for salmonids. A short reach between Mt. Hermon Road and Ruins Creek has historically supported an intact riparian corridor and good pool cover provided by instream wood in a meandering stream channel. This short reach is periodically a very productive steelhead segment. Upstream of the Ruins Creek confluence, summer baseflows are low, with variable segments frequently drying out. Upstream of the Mackenzie Creek confluence, summer baseflows remain low and steelhead are restricted to available pool habitats. Juvenile coho salmon were observed in this low gradient, cool water reach in 2005 (DWA 2009). Surface flow in upper Bean Creek is thought to be vulnerable to groundwater pumping (DWA 2009).

Newell Creek is a tributary to the San Lorenzo River in Ben Lomond. The Loch Lomond Reservoir is located on Newell Creek approximately 1.7 miles upstream of the San Lorenzo River confluence. Below the reservoir, Newell Creek has approximately one mile of easily accessible steelhead habitat below a bedrock chute that presents a significant impediment to fish passage (HES 2014). Winter spawning flows are likely much reduced in Newell Creek until the reservoir fills and spills in winter (DWA 2009). The water right license for Loch Lomond requires year-round minimum releases of 1 cfs to Newell Creek. Hydrologic modeling indicates that the operation of the reservoir results in a slight reduction in median flows (compared to reservoir inflows) through the anadromous reach during the early part of the juvenile salmonid rearing period in wet, normal and dry years, and in an augmentation of median flows during the latter part of the rearing period due to the 1 cfs minimum release requirement (ENTRIX, Inc. 2004, cited in HES 2012).

Exponent (2019) evaluated the potential effects of groundwater extraction on streamflow by comparing rates of average annual pumping to minimum rates of stream baseflow, assuming a 1:1 relationship (i.e., one gallon of groundwater pumped from the aquifer equates to one less gallon of streamflow). Based on this worst-case effect assumption, Exponent (2019) estimated that cumulative average rates of SLVWD, SVWD, and MHA groundwater pumping may reduce Newell, Zayante, and Bean Creek baseflows by as much as roughly 50 percent during worst case drought conditions. A more refined evaluation of potential surface water-groundwater

[5] In 2015, SLVWD assimilated the Lompico County Water District, including its diversion on Lompico Creek. However, this water source is not considered in the conjunctive use plan evaluation.

interactions would require the use of a numerical groundwater flow model, which was beyond the scope of the Exponent (2019) analysis.

1.4.4 Summary

The fisheries resource considerations assessment (Podlech 2019) for the San Lorenzo River Watershed Conjunctive Use Plan concluded that SLVWD's typical surface water diversion rates constitute a minor portion of the winter high flow season. Beginning in May, the diversions account for gradually increasing percentages of the unimpaired flow. During summer (July through September) baseflow conditions, SLVWD's diversions have variable effects on fisheries resources depending on water year type, diversion rates, and downstream resource sensitivity. During drought baseflow conditions, surface water diversions likely reduce streamflows sufficiently to exacerbate already stressful juvenile salmonid rearing conditions, particularly in Boulder Creek. Water temperatures are generally not affected by surface water diversions such that rearing habitat suitability downstream of the diversions is altered.

The effects of groundwater extractions on eastern watershed tributaries (e.g., Zayante and Bean creeks) are also largely inconsequential during most of the year but may result in reductions of up to 50 percent of drought minimum baseflows in these streams during critically low flow periods.

Table 1-1 summarizes typical effects of SLVWD's diversions and pumping on San Lorenzo River watershed streams.

TABLE 1-1

SUMMARY OF ESTIMATED EFFECTS OF SLVWD SURFACE WATER DIVERSIONS AND GROUNDWATER EXTRACTIONS ON SAN LORENZO RIVER WATERSHED STREAMS

Surface Water Sources	Typical maximum diversion rate (cfs)	Typical Jul-Sep diversion rate (cfs)	Jul-Sep diversion % of receiving stream* flow	Steelhead temperature suitability criterion met	Coho salmon temperature suitability criterion met
Peavine/Foreman Creeks	2.0	<0.25	>20	✓	X ✓
Clear/Sweetwater Creeks	0.7	<0.1	<9	✓	✓
Fall/Bennett Creeks	0.9	0.5	<10	✓	✓
Bull Creek	0.3	0.1	<5	✓	X ✓

Groundwater Sources	Estimated Mean Monthly Loss (cfs) from SLVWD Groundwater Production	% Loss of Drought Minimum Baseflow from SLVWD Groundwater Production
Newell Creek at San Lorenzo River	0.1	49
Zayante Creek above Bean Creek	0.4	53
Zayante Creek at San Lorenzo River		27
Bean Creek at Zayante Creek	0.9	23
San Lorenzo River above Fall Creek	0.1	7
San Lorenzo River at USGS gage		16

* = next downstream named waterbody (e.g., San Lorenzo River in the case of Fall Creek)
✓= typically meets criterion
X ✓= typically meets criterion during wet and normal water years, but not in dry years

1.5 Planning Context

1.5.1 State of California Sustainable Groundwater Management Act

Under the Sustainable Groundwater Management Act (SGMA) of 2014, overdrafted groundwater basins need to be sustainably managed by a Groundwater Sustainability Agency (GSA) through the development of a Groundwater Sustainability Plan (GSP). The GSPs must be completed by 2022, and the basin must reach sustainability, as defined in the GSP, by 2042. The Santa

Margarita Groundwater Basin is in a state of overdraft due to decades of overpumping – exctracting water at a higher rate than it can be recharged to the basin. Groundwater levels are approximately 200 feet below their natural levels in some aquifers. While these levels are no longer decreasing, low groundwater levels mean less water in the streams for fish and wildlife, and less water security for people.

The Santa Margarita Groundwater Agency (SMGWA) is a GSA formed as a Joint Powers Authority in June 2017 and consists of three member-agencies: SLVWD, SVWD, and the County. The GSA is governed by the Board of Directors comprised of two representatives from each member agency, one representative each from the City of Scotts Valley, City of Santa Cruz, and MHA, and two private well owner representatives. The Board of Directors holds monthly meetings that are open to the public. The staffing support and funding for the agency is provided by the member agencies. SMGWA is in the process of developing a GSP that will guide activities to prevent further reduction in groundwater levels and the negative impacts it causes, and also consider ways to restore groundwater levels. Projects implemented under this *San Lorenzo River Watershed Conjunctive Use Plan* will form integral components of the Santa Margarita Groundwater Basin GSP.

1.5.2 City of Santa Cruz Anadromous Species Habitat Conservation Plan

As noted above, the City of Santa Cruz Water Department has been developing an HCP with CDFW and NMFS for California Endangered Species Act and Federal Endangered Species Act compliance for water supply operations that may affect special-status anadromous salmonids, specifically coho salmon and steelhead. The process has been lengthy due to the nature of the data required for long-term permitting, the inherent challenges of balancing water supply with environmental water demands, agency staff changes, the drought of 2012 through 2015, and other related factors (City of Santa Cruz 2018).

To protect endangered coho salmon and threatened steelhead trout, the City has negotiated minimum stream flow requirements (Agreed Flows) with CDFW and NMFS as part of the HCP process, including at its two San Lorenzo River diversion sites (Felton and Tait Street), both of which are located downstream of the confluences of SLVWD source water tributaries. Draft descriptions of the Agreed Flows were reviewed and considered during preparation of this conjunctive use plan in an effort to ensure that projects implemented under this plan would not conflict with the anticipated final HCP that is expected to be completed by late 2021 or early 2022 (City of Santa Cruz 2018).

CHAPTER 2
Conjunctive Use Scenarios

2.1 Background

Exponent (2019) prepared a water availability assessment (WAA) to support the development of this *San Lorenzo River Watershed Conjunctive Use Plan*. The WAA identifies options for increasing water supply reliability and dry season streamflows through the conjunctive use of available surface water and groundwater resources and defines the following four objectives for the conjunctive use plan:

- Optimizing the conjunctive use of available water resources for water-supply reliability and long-term sustainability;
- Reducing Felton diversions during low-flow and dry-period conditions and compliance with water rights restrictions;
- Reducing the effect of North system stream diversions and groundwater pumping on dry-period streamflows;
- Reducing groundwater pumping (e.g., by in-lieu recharge) to promote the recovery of groundwater storage and production in the South system and other portions of Scotts Valley.

The WAA considered the following means for achieving these objectives:

- Using the inter-system emergency interties to provide:
  - The Felton service area with excess water produced by the other two service areas at times when Felton system diversions are restricted.
  - The South system and possibly SVWD with excess stream diversions from the Felton and North systems.
  - The North system with excess diversions from the Felton system.
- Using SLVWD’s Loch Lomond Reservoir allotment to reduce Felton system diversions, South system groundwater pumping, and North system diversions and groundwater pumping.

- Using excess surface water to supply an aquifer storage and recovery (ASR) project in the Olympia wellfield.

Based on the above objectives and considered means, the WAA identified and analyzed a total of 22 conjunctive use scenarios. In accordance with the above objectives, the conjunctive use scenarios were focused primarily on water supply reliability and sustainability, with particular emphasis on groundwater sustainability. A subsequent fisheries considerations analysis of the WAA results (Podlech, 2019) identified an additional scenario as representing the most beneficial alternative for fisheries resources. Johnson (2019) analyzed the water supply and conjunctive use implications of this additional scenario, identified as Scenario 3d, consistent with the methods used in the original WAA. This chapter provides an overview of the analytical approach and results of the Exponent (2019) and supplemental Johnson (2019) water availability analyses. Detailed discussions of the alternatives selected by SLVWD for implementation are provided in Chapters 3 and 4.

2.2 Water Availability Analysis Approach

For each of the alternatives, Exponent (2019) and Johnson (2019) performed an analysis of monthly water supply, water production, and projected 2045 water demand over a 48-year climatic cycle. The WAA estimated monthly streamflows and potential diversions based on estimated frequencies of mean daily flow adjusted for month and hydrologic year-type (e.g., wet, dry, etc.) based on the following assumptions:

- The evaluated climatic cycle is a repeat of the 48-year period from October 1969 through September 2017, i.e., water years (WYs) 1970–2017. This period includes three critical drought periods, WYs 1976–1977, 1987–1992, and 2012–2016, and is reasonably well supported by historical precipitation, streamflow, and water production records. The potential impacts of climate change on water supplies were not considered.

- Average annual water demand for each service area for the design climatic cycle is based on 2045 demands projected by the 2015 SLVWD Urban Water Management Plan (UWMP) (WAC 2016)[6]. Water-year and monthly demand is varied in response to the climatic cycle in a manner similar to the historical record.

- The effective capacities of existing stream diversions, groundwater wells, pipelines, and treatment plants are approximated from near-maximum monthly rates achieved during the historical record.

- Estimates of monthly total, divertible, bypassed, and downstream flows were simulated from estimated monthly frequencies of mean daily flow, adjusted for water-year percent-of-average streamflow. Synthetic monthly flows of the San Lorenzo River and Boulder Creek were generated using the same method to trigger Felton system diversion

[6] SLVWD recently adopted its 2020 UWMP. However, the WAA was prepared in 2018 based on 2015 UWMP demand projections.

restrictions and used to evaluate the effect of diversions on downstream flows. This method improved upon previous conjunctive use analyses that used monthly timesteps without accounting for daily flow variability.

- The historical record of groundwater pumping, groundwater levels, and precipitation was used to estimate sustainable rates of seasonal groundwater production during average and wet years, and reduced rates of production as a result of lowered groundwater levels during drought years. The application of numerical models to obtain more dynamic estimates of groundwater-surface water interactions was outside the scope of the WAA.

On these assumptions, alternative conjunctive use scenarios were compared to a base case calibrated to SLVWD's proportional use of surface water and groundwater during WYs 2000-2017. The simulated base case and alternative conjunctive use scenarios analyzed in the WAA are defined and grouped as follows:

- Base case – Calibrated to SLVWD’s actual average, minimum, and maximum proportional use of surface water and groundwater sources during WYs 2000–2017; excluding the use of existing system interties.

- Scenario 1 – Optimizes the use of currently available sources using system interties and potential capacity enhancements assuming varying degrees of compliance with existing water rights; achieves Pasatiempo area in-lieu recharge by substituting excess North and Felton diversions for groundwater pumping.

- Scenario 2 – Scenario 1 plus use of SLVWD’s allotment of water stored in Loch Lomond reservoir.

- Scenario 3 – Scenario 2 plus operation of an Olympia ASR project supplied by excess available stream diversions.

- Scenario 4 – Scenario 3 plus additional Scotts Valley in-lieu recharge by substituting excess available SLVWD surface water for SVWD groundwater pumping.

Scenarios 1, 2, and 3 include multiple alternatives. **Table 2-1** summarizes the assumptions underlying fifteen Scenario 1 alternatives, three Scenario 2 alternatives, four Scenario 3 alternatives, and one Scenario 4 alternative.

TABLE 2-1
SUMMARY OF CONJUNCTIVE USE SCENARIO ALTERNATIVES ASSUMPTIONS (SELECTED SCENARIOS HIGHLIGHTED)

No.	Base Case and Alternative Conjunctive Use Scenarios	Stream Diversion Capacities		Felton System Water Rights			Stream Diversion Exports Using System Interties						Import from Loch Lomond			Scotts Valley In-Lieu Recharge with Exported Diversions	
							North System to			Felton System to							
		Exist-ing	Double	Comply	Not Comply	Comply with Bypass Only	Felton Sys-tem	South Sys-tem	Olym-pia ASR	South Sys-tem	North Sys-tem	Olym-pia ASR	to North Sys-tem	to Felton Sys-tem	to South Sys-tem	from North System	from Felton System
	Historical Record, WYs 2000-2017	▬			▬		◇	◇									
	Synthesized Records, WYs 1970-2017:																
1	**Base case Simulated** historical record (calibrated to WYs 2000-2017)[a]	▬			▬												
	Scenario 1 Alternatives Using Existing and Modified Infrastructure and Water Rights Variations																
2	**1a.** Felton system complies with water rights.	▬		○													
3	**1b.** Felton system complies with required bypass flows, but not SLRBT low-flow no-diversion requirements	▬				○											
4	**1c.** All diversion capacities doubled; Felton system complies with water rights.		▬	○													
5	**1d.** All diversion capacities doubled; Felton system diverts without regard to water rights.		▬		▬												
6	**1e.** All diversion capacities doubled; Felton system complies with required bypass flows only.		▬			○											
7	**1f.** South system imports North system unused potential diversions for in-lieu recharge; Felton system complies with water rights.	▬		○			X	▬									
8	**1g1.** South system imports Felton system unused potential diversions for in-lieu recharge; Felton system diverts without regard to water rights.	▬			▬		X			▬							
9	**1g2.** Scenario 1g1 except Felton system complies with water rights.	▬		○			X			▬							
10	**1g3.** Scenario 1g1 except Felton system complies with required bypass flows only.	▬				○	X			▬							
11	**1g4.** Scenario 1g2 except intertie capacities limited.	▬		○			X										
12	**1h1.** South system imports unused potential diversion from North and Felton systems for in-lieu recharge; Felton system diverts without regard to water rights.	▬			▬		X	▬		▬							
13	**1h2.** Scenario 1h1 except Felton system complies with water rights.	▬		○			X	▬		▬							
14	**1i.** North system imports Felton system unused potential diversions for in-lieu recharge; Felton system complies with water rights.	▬		○			X				▬						
15	**1j.** Scenario 1i plus South system imports unused potential diversion from North and Felton systems.	▬		○			X	▬		▬	▬						
16	**1k.** Scenario 1j except intertie capacities limited.	▬		○			X	▬		¡	¡						
	Scenario 2 - Import from Loch Lomond																
17	**2a.** North and Felton systems import from Loch Lomond to satisfy unmet demand in Scenario 1a.	▬		▬			X						▬	▬			
18	**2b.** Scenario 2a plus South system imports from Loch Lomond for in-lieu recharge.	▬		▬			X						▬	▬	▬		
19	**2c.** Scenario 2b plus South system also imports North system unused diversions, and North system imports unused Felton system diversions.	▬		▬			X	▬			▬		▬	▬	▬		
	Scenario 3 - Import from Loch Lomond and Operate Olympia Aquifer Storage and Recovery (ASR)																
20	**3a.** Scenario 2b plus North system operates Olympia area ASR using North system unused diversions.	▬		▬			X		◉					▬	▬		
21	**3b.** Scenario 2b plus North system operates Olympia area ASR using Felton system unused diversions.	▬		▬			X					▬		▬	▬		
22	**3c.** Scenarios 3a and 3b combined.	▬		▬			X		◉			▬		▬	▬		
*23**	***3d.*** *Scenario 3c, but replace Peavine/Forman baseflow diversions with pumping from Olympia wells*	▬		○			X		◉			▬		▬	▬		
	Scenario 4 - Contribute to Scotts Valley In-Lieu Recharge while Operating Olympia ASR and Importing from Loch Lomond																
24	**4.** Scenario 3c plus SVWD imports North and Felton system remaining unused potential diversions.	▬		▬			X		◉			▬		▬	▬	▬	▬

▬ Base case condition or scenario assumption.
◇ Minor use since 2016.
○ Water rights compliance results in unmet demand some years.
X North system has no unused diversions when needed by Felton.
¡ Intertie capacities limited to rated values.
◉ Diversions exported to Olympia ASR; imported back to North system.
All scenarios assume estimated 2045 demand and repeat of WY1970-2017 climatic cycle.
[a] Simulated base case does not reflect minor use of system interties in actual use since 2016.
** Additional scenario identified after completion of WAA*

SOURCE: adapted from Exponent (2019) and Johnson (2019)

2.3 Water Availability Analysis Results

The water supply analyses for each alternative consisted of four parts: (1) a model of monthly water demand, (2) synthetic records of monthly unimpaired flows and potentially divertible flows, (3) estimates of sustainable groundwater yield, including estimated yield reductions during drought and heavy demand; and (4) a monthly accounting of demand and supply for an assumed set of production capacities and an assumed prioritized use of individual surface water and groundwater sources. To compare streamflow effects of the various conjunctive use scenarios to the base case and each other, the evaluation of each alternative includes estimates of (a) the percent reductions in unimpaired flow downstream of simulated diversions and impaired flow downstream in Boulder Creek and the San Lorenzo River; and (b) percent reductions in drought minimum stream baseflow down gradient of simulated wells.

The Exponent (2019) WAA and subsequent Johnson (2019) evaluation provide quantitative discussions of the alternatives analyses results to allow for direct comparisons between the 23 conjunctive use scenarios. The following summarizes the overall findings of these analyses.

- Potential water transfers using system interties are insufficient to achieve full Felton water rights compliance. The North system has no unused potential diversions available during months when the Felton system is not in compliance, and increased production from the Pasatiempo wells for transfer to Felton would require locally unprecedented rates of production from an over-drafted aquifer. A supplemental source, such as imports from Loch Lomond, may be needed more than 20 percent of the time to fully comply with current water right permit requirements.

- Complying with the Felton system water rights notably increases the minimum percentages of flows remaining downstream, particularly in Bull Creek.

- Estimated increases in water production resulting from assumed increases in stream diversion capacity indicate a potential to increase yields from SLVWD's diversion streams.

- South system imports of North and/or Felton system unused potential diversions allow 30 to greater than 50 percent reductions in South system groundwater production.

- Supplementing the North system with Felton system unused potential diversions provides a 20 percent reduction in North system groundwater pumping.

- Supplementing the North system with extractions from a hypothetical ASR project supplied by North and/or Felton unused potential diversions provides roughly 30 to 60 percent net reductions in North system groundwater pumping.

- Stream diversions for in-lieu recharge and ASR occur during high-flow periods and have relatively little effect on minimum flows remaining downstream of the diversions.

- Use of SLVWD's Loch Lomond allotment allows the Felton system to comply with its permitted water rights as well as reduce South system groundwater pumping by roughly 60 to 70 percent; as a result, unused North and Felton system potential diversions are available for ASR instead of South system in-lieu recharge.

- A 60 to 70 percent reduction in South system groundwater pumping as a result of imports from Loch Lomond and/or unused potential diversions represents a significant contribution to SMGB groundwater storage recovery. The degree to which SLVWD could recover this storage is currently unknown.

- Using the system interties to supply the South system with unused potential diversions uses roughly 40 and 50 percent of North and Felton system unused diversions, respectively.

- With the addition of a Loch Lomond supply, optimal use of North and Felton unused potential diversions requires ASR. As simulated under optimal conditions, ASR uses roughly half of the remaining unused diversions and helps reduce North system groundwater pumping by roughly 30 to 60 percent.

- Reduced groundwater pumping as a result of imports from Loch Lomond and the transfer of unused diversions increase the percentage of drought minimum baseflows estimated to remain in lower Newell, Zayante, and Bean creeks to 60 to 80 percent, compared to 50 percent or less for the base case.

- The remaining North and Felton system potential unused diversions (i.e., exceeding the capacity of the hypothesized ASR project) are assumed to be available for export to SVWD, which would further contribute to the recovery of SMGB groundwater storage.

Figure 2-1 provides a summary of the base case and alternative conjunctive use scenarios simulated average annual North, Felton, and South system water production by source, percent reductions in groundwater pumping, compliance with Felton system water rights, and average annual amounts of unused stream diversions and Loch Lomond allotment for each scenario. **Figure 2-2** compares the minimum percentage of monthly streamflow simulated to remain downstream of SLVWD's diversions for each scenario during the simulation period, and **Figure 2-3** compares the minimum percentage of estimated drought stream baseflow remaining as a result of the groundwater pumping assumed for each scenario.

In summary, the WAA concluded that system interties combined with potential supplemental water supplies provide SLVWD with significant options and flexibility for increasing conjunctive use and improving stream baseflows.

It is important to note that the results of the WAA are intended to guide planning-level evaluation of conjunctive-use alternatives. The scenarios were simulated under optimal, hypothetical conditions without full regard for infrastructure and other operational limitations, and as such likely overestimate potential yields. The actual yield of modified infrastructure will depend on numerous factors beyond the scope of this analysis. The presented values of simulated monthly flow have limited precision and should not be used to evaluate compliance with specific regulatory, water right, or habitat requirements. Evaluating the effects of groundwater pumping on streamflow, beyond the approach used for the WAA, would require use of a calibrated numerical groundwater flow model, which was not within the scope of this study.

2.4 Conjunctive Use Scenario Selection

SLVWD selected the following four conjunctive use scenarios for inclusion in this *San Lorenzo River Watershed Conjunctive Use Plan* based on the simulated water supply sustainability improvements, infrastructure needs, and streamflow benefits presented in the Exponent (2019 and Johnson (2019) water availability analyses:

- *Scenario 1b (Felton system complies with required bypass flow only)*: Under this scenario, SLVWD would continue to comply with its Fall Creek bypass flow requirement but petition the State Water Board to amend water right Permit 20123 to relieve the District of the SLRBT low flow requirement. Although the Felton system could fully comply with all water right permit requirements with imports from a supplemental source such as Loch Lomond allotment and/or ASR, the fisheries effects evaluation (Podlech 2019) concluded that using those sources for in-lieu recharge and/or reductions in summer surface water diversions from North system streams would likely result in streamflow and fisheries benefits that outweigh the benefits achieved through compliance with SLRBT low-flow diversion thresholds.

- *Scenario 1f (South System Imports North System Unused Potential Diversions)*: Implementation of this project would utilize an existing emergency intertie and not require infrastructure improvements while promoting moderate simulated drought baseflow increases in eastern watershed tributaries affected by groundwater pumping.

- *Scenario 2b (South System Imports from Loch Lomond for In-Lieu Recharge)*: Implementation of this project would also utilize existing emergency interties, but require some infrastructure improvements (e.g., water treatment upgrade). Simulated drought baseflow increases in eastern watershed tributaries affected by groundwater pumping would be significant, especially when implemented in conjunction with Scenario 1f above.

- *Scenario 3d (North System Operates ASR Project Using North and Felton System Unused Potential Diversions, and Reduces Baseflow Diversions from North System)*: Implementation of this scenario would require significant planning and feasibility analysis as well as substantial infrastructure investments (e.g., construction of ASR system), but would provide SLVWD with added water storage capacity as well as improved water supply flexibility and groundwater sustainability. The project would also benefit dry season streamflows throughout much of the San Lorenzo River watershed.

SLVWD operations, infrastructure needs, water supply and fisheries effects, and water right implications associated with implementation of these four conjunctive use projects are discussed in detail in the next two chapters.

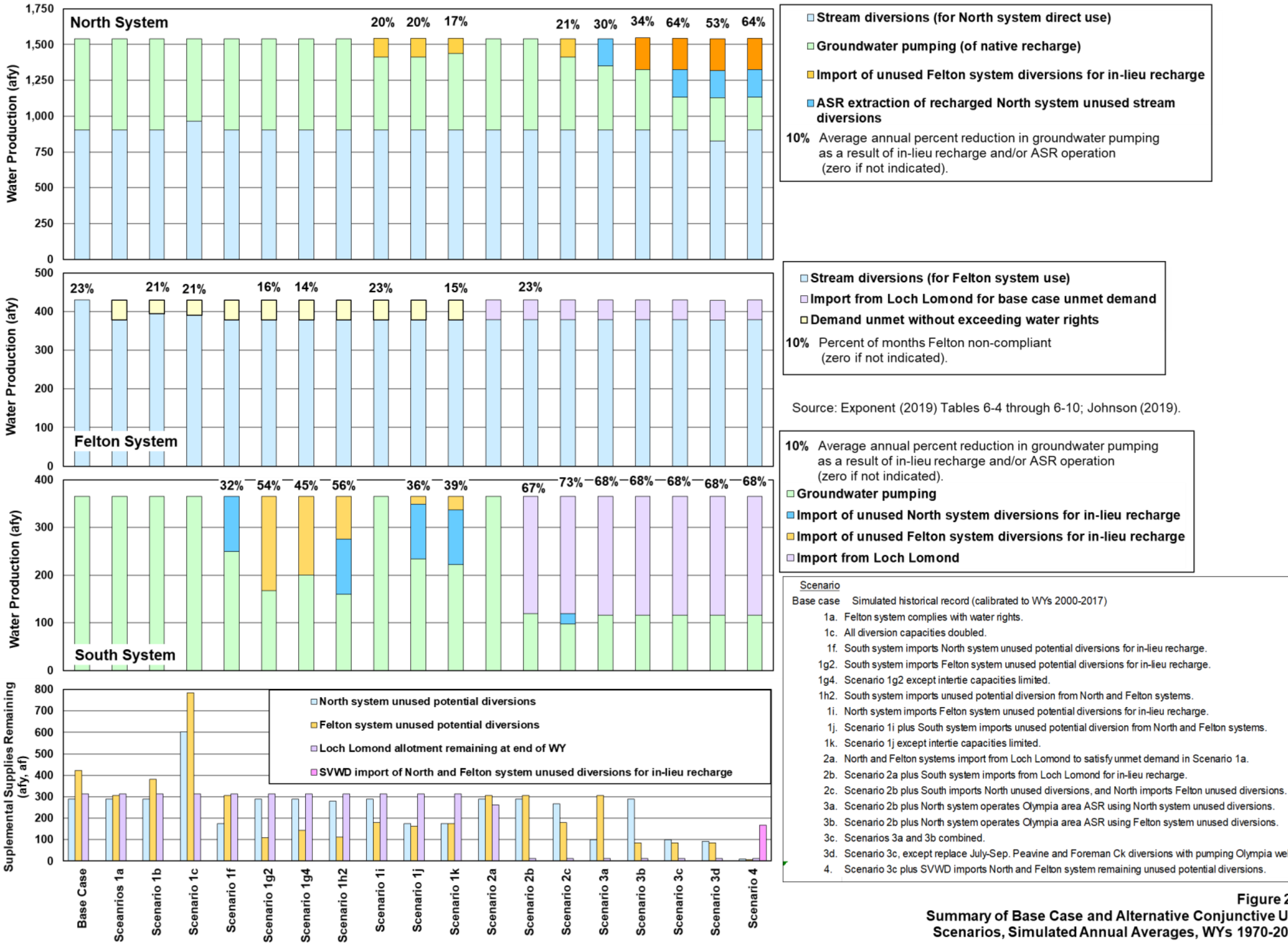


Figure 2-1
Summary of Base Case and Alternative Conjunctive Use Scenarios, Simulated Annual Averages, WYs 1970-2017

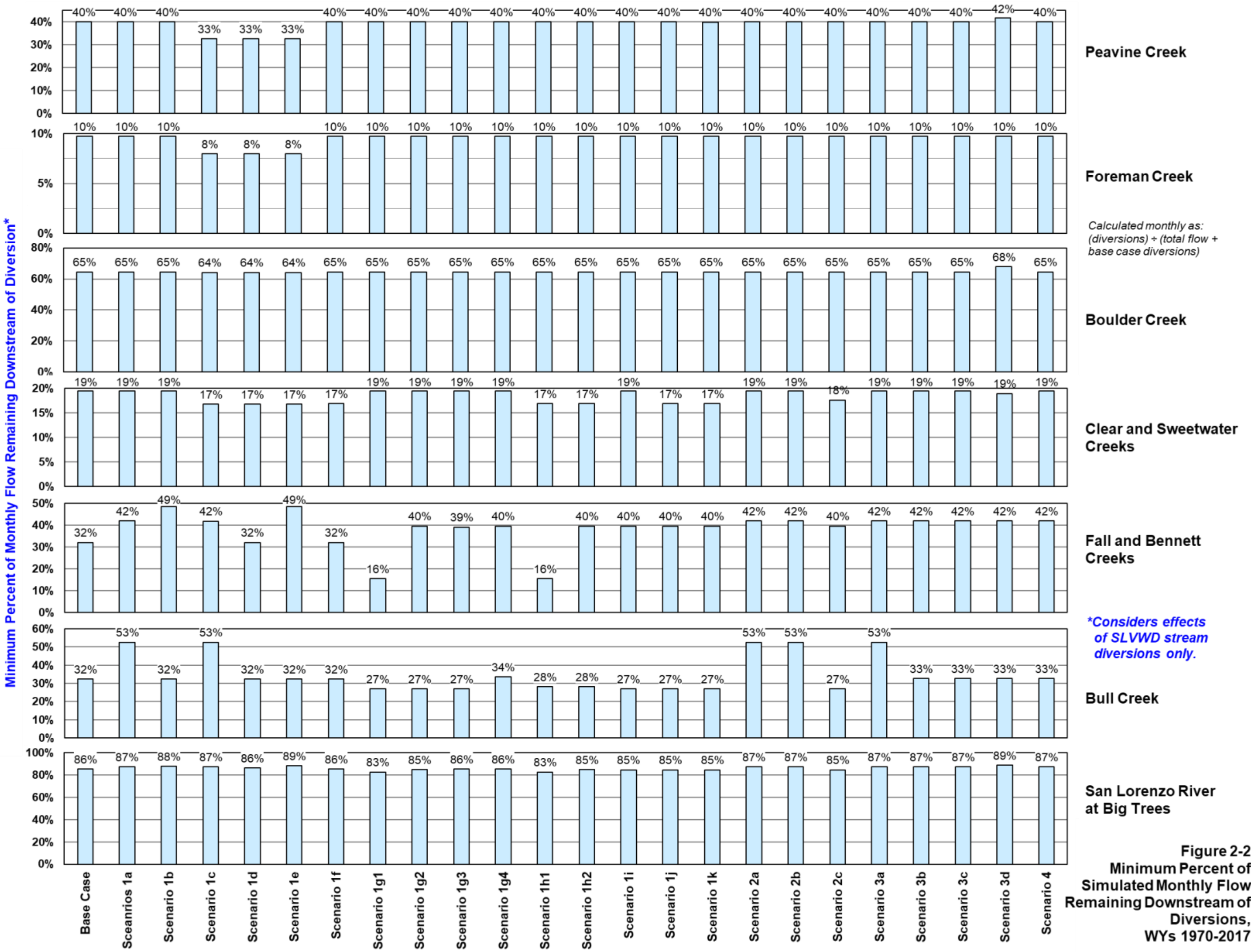


Figure 2-2
Minimum Percent of Simulated Monthly Flow Remaining Downstream of Diversions, WYs 1970-2017

SOURCE: Exponent (2019), Johnson (2019)

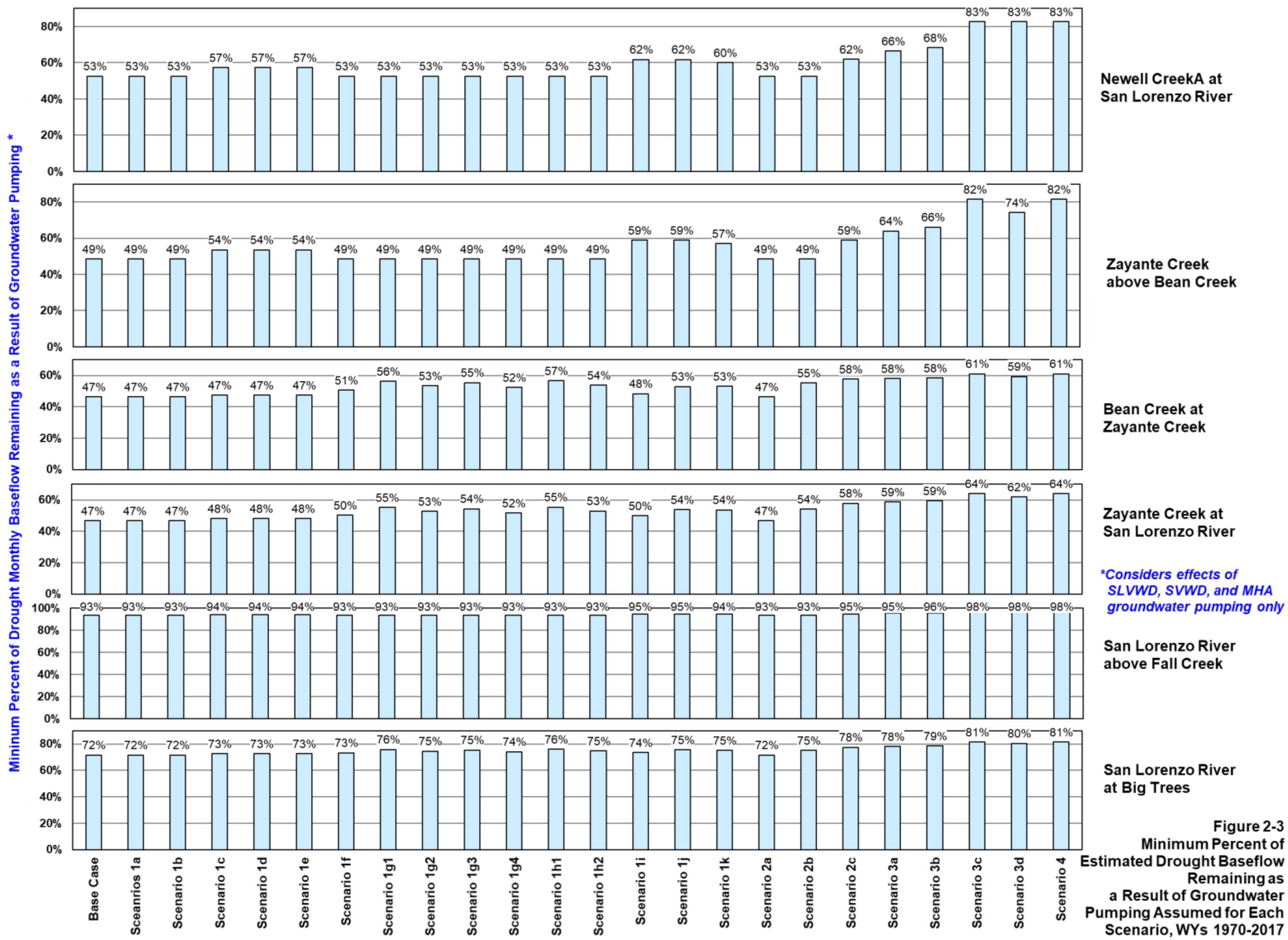


Figure 2-3
Minimum Percent of Estimated Drought Baseflow Remaining as a Result of Groundwater Pumping Assumed for Each Scenario, WYs 1970-2017

SOURCE: Exponent (2019), Johnson (2019)

CHAPTER 3

Phase 1: Near-Term Conjunctive Use Plan Implementation

This chapter describes conjunctive use projects proposed to be implemented in the short-term (i.e., within the next five years). Neither of the two Phase 1 projects require construction of new or modified infrastructure as the proposed projects are limited to changes in current operational authorizations.

3.1 Scenario 1b: Felton System Complies with Required Bypass Only

3.1.1 Description of Scenario

SLVWD's Felton water right Permit No. 20123 contains two instream flow requirements (see Section 1.3.1). Permit Term 12 stipulates minimum bypass flow requirements for Fall Creek below the Fall Creek diversion facility. This requirement varies depending on season and water year type, and compliance with this requirement only affects SLVWD operations at the Fall Creek diversion facility. Permit Term 13, on the other hand, sets low-flow thresholds for the San Lorenzo River at the SLRBT gage for the months of September through May and does not allow SLVWD to divert from any of its Felton system sources (i.e., Fall Creek, Bennett Spring and Creek, and Bull Creek) under Permit 20123 unless those low-flow thresholds are met, thereby potentially leaving the Town of Felton without adequate municipal water supply for an extended period of time. It is not uncommon for SLRBT summer and early fall flows to be well below the low-flow requirements regardless of SLVWD's diversions. Exponent (2019) analyzed the frequency of low-flow conditions at SLRBT, as defined by the water right permit terms, for a 48-year period of SLRBT records (WYs 1970-2017). On an average monthly flow basis, SLRBT flows were below Term 13 thresholds during the month of October in 31 out of 48 years (65 percent) and during the month of November in 11 out of 48 years (23 percent) (**Table 3-1**). For example, during recent drought years, SLRBT flows were below the threshold requirement during October 2013 through January 2014, May 2104, September through November 2014, May 2015, and September through November 2015. Due to public health concerns, SLVWD has continued to divert from the Felton system during these periods and may therefore periodically be out of compliance with Term 13 of its water right permit, although SLVWD's licenses continue to allow more limited diversions during such periods.

In contrast, SLVWD is generally able to remain in compliance with its permitted Fall Creek bypass flow requirement (Term 12), although during the extreme drought years of 2014 and 2015, estimated bypass flows at Fall Creek facility periodically fell below the 0.5 cfs dry year summer bypass requirement in

August and September.[7] During normal and wet years (e.g., WYs 2016-2018), summer bypass flows at the Fall Creek diversions typically exceed 1-2 cfs.

TABLE 3-1

FREQUENCY OF LOW-FLOW CONDITIONS RESTRICTING FELTON SYSTEM DIVERSIONS DURING A 48-YEAR PERIOD OF SLRBT RECORDS (WYS 1970-2017) ON AN AVERAGE MONTHLY FLOW BASIS

October	65%	April	2%
November	23%	May	13%
December	6%	June	0%
January	4%	July	0%
February	2%	August	0%
March	0%	September	17%
		All months	**11%**

Source: Exponent (2019)

The WAA (Exponent 2019) evaluated potential conjunctive use water transfers scenarios to achieve full Felton water rights compliance (WAA Scenario 1a) using existing system interties and diversion capacities but concluded that existing supplies are insufficient. The North system has no unused potential diversions available during months when the Felton system may be out of compliance with the SLRBT requirement, and increased production from the South system's Pasatiempo wells for transfer to Felton would require locally unprecedented rates of production from an already over-drafted aquifer, potentially exacerbating adverse effects to Zayante and Bean creeks baseflows and fish. Exponent (2019) concluded that full compliance with the existing Felton system water right permit would only be possible with a supplemental source of water, such as imports from Loch Lomond, or new storage infrastructure, such as an aquifer storage and recovery (ASR) project.

The WAA also considered Scenario 1b in which SLVWD would continue to comply with the Fall Creek bypass flow requirement (Term 12) but petition the State Water Board to amend water right Permit 20123 to relieve SLVWD of the SLRBT low flow requirement (Term 13). SLVWD recognizes that implementation of Scenario 1b, as proposed, is not a conjunctive use project in and of itself. No inter-system water transfers would occur under this scenario and no changes in the rates or timing of surface water diversions or groundwater extractions would occur. As described above, the WAA concluded that full compliance with all existing permit terms would require the use of supplemental sources (e.g., Loch Lomond allotment and/or ASR) to fully meet Felton system demand, and various potential conjunctive use alternatives that would achieve that were analyzed (i.e., Scenarios 2 and 3). However, the fisheries resources considerations assessment (Podlech 2019) concluded that the use of supplemental sources toward offsetting groundwater pumping and summer surface water diversions would provide greater fisheries resource benefits than compliance with the existing SLRBT low flow requirements. Three such

[7] SLVWD's diversions may have been out of compliance with the Fall Creek bypass flow requirement in August and September 2015 (see Figure 2-9 in Balance Hydrologics 2018a) during severe drought conditions. It should be noted, however, that significant weir leakage was subsequently observed in summer 2018 during fish ladder maintenance, indicating that the v-notch weir in use in WY 2015 likely underestimated flows bypassing the diversion.

conjunctive use projects (Scenarios 1f, 2b, and 3d, below) are being considered for implementation under this *San Lorenzo River Watershed Conjunctive Use Plan*. Therefore, while Scenario 1b is not a conjunctive use project, its implementation would allow SLVWD to maximize the fisheries enhancement benefits of other conjunctive use projects considered under Phase 2 of this plan. Moreover, the estimated direct and indirect streamflow benefits of those projects would be realized in tributaries to the mainstem San Lorenzo River upstream of the SLRBT and would therefore extend across a greater portion of the watershed and ultimately extend to SLRBT and the lower San Lorenzo River.

3.1.2 Operations

Considering SLVWD currently complies with the existing Fall Creek bypass flow requirements during all but the most severe drought conditions, but generally continues to divert some water from its Felton system sources for public health reasons even when the SLRBT flows are below the permitted low-flow threshold, SLVWD's operations under Scenario 1b would remain unchanged from current operations. The only change would consist of harmonizing those operations with revised water right permit terms.

3.1.3 Infrastructure

No infrastructure changes or upgrades are necessary to implement Scenario 1b. SLVWD would continue to use the existing surface water diversion structures, pipelines, and treatment plant. No changes to diversion, delivery, or treatment capacities are necessary.

3.1.4 Anticipated Effects

Water Supply

Under existing operations, SLVWD meets the Felton system average annual demand of 430 af, but a portion of this supply at times may have been diverted out of compliance with its existing water right permit. With implementation of Scenario 1b, SLVWD's Felton system diversions would be harmonized with amended low-flow requirements, but continued compliance with the existing Fall Creek bypass flow requirements would result in unmet demand during drought years. Periodic transfers from Loch Lomond and/or an ASR project will be necessary to satisfy this unmet demand (see Chapter 4).

Fisheries

While SLVWD's ability to fully comply with its water right permit is clearly an important legal and regulatory consideration, the fisheries considerations evaluation (Podlech 2019) focused on maximizing the potential benefits of conjunctively managing SLVWD water supplies for fisheries resources in the San Lorenzo River watershed as a whole. In this context, Podlech (2019) assessed the potential fisheries effects of eliminating the SLRBT low-flow requirement, as summarized below.

The underlying purpose of water right permit restrictions on diversions broadly falls into one of two categories: (1) protecting other water rights holders, and (2) protecting other beneficial uses, including environmental resources such as fisheries. Based on a review of State Water Board Decision 1611 (SWRCB 1986) approving Citizens Utility Company of California (prior owner and operator of the Felton system) water right application 24652, water right Permit 20123 contains both categories of terms. The bypass flow requirements for Fall Creek are based on protest dismissal terms recommended by

CDFG (now CDFW) and the County of Santa Cruz for the protection of fisheries resources in Fall Creek below the diversion. The bypass requirement at the SLRBT gage, on the other hand, appears to have been included primarily based on a proposal of the City of Santa Cruz seeking to harmonize SLVWD's upstream water rights with the City's water rights at the Felton Diversion, the permits for which included the same bypass terms at that time.

Although the City's permitted bypass terms at SLRBT were originally "proposed by the Department" (i.e., CDFG) "to protect fisheries within the river" (SWRCB 1986), Decision 1611 notes that the City's stated concern regarding the potential adverse effects of Citizens United's application on fish in the San Lorenzo River "is unsubstantiated since the proposed diversion is small compared to the total flow in the mainstem San Lorenzo River especially during the fish migration months of November through June" (SWRCB 1986).

The original CDFG justification for proposing the inclusion of the SLRBT bypass terms in the City's permits, and by extension in SLVWD's permit, is not provided in Decision 1611 and was not available for this assessment. From a fisheries perspective, however, potential justifications for the SLRBT requirements are difficult to conceive of, primarily due to the unusual monthly steps in minimum flow requirement levels that do not appear to be founded in the life history periodicity of anadromous salmonids in the San Lorenzo River. The permitted minimum flow requirement schedule increases from 10 cfs in September to 25 cfs in October, prior to the onset of the typical adult steelhead (December) and coho salmon (November) migration periods. Chinook salmon (*O. tshawytscha*) are the only central California anadromous salmonid species migrating as early as October, and this species does not occur in the San Lorenzo River. Furthermore, unless a major storm event has occurred by the time the October bypass threshold goes into effect, the sandbar at the San Lorenzo River Lagoon would most likely still be closed, thereby preventing all adult salmonid entry into the watershed. More confounding than the September-to-October increase in the minimum flow requirement, however, is its subsequent *decrease* to 20 cfs in November, the early onset of potential adult salmonid migration. Per the permit terms, this requirement remains in effect through May and thus the entire salmonid migration and spawning season. The stipulated increase in the minimum flow requirement in early fall and subsequent decrease in late fall through spring is highly unusual and possibly unique in flow management and regulations for the benefit of steelhead and coho salmon in costal California and does not appear to be ecologically justified.

Regardless of this minimum flow schedule anomaly, the permitted flow requirements themselves are also insufficient for the assumed purpose of protecting adult salmonid passage in the San Lorenzo River below the SLRBT gage. Salmonid passage flow needs in the San Lorenzo River below the City's Felton Diversion have previously been estimated by a number of researchers, as summarized by Berry (2016). Based on its interpretation of the findings of these studies, the City has recently proposed a commitment to bypassing up to 40 cfs at the Felton Diversion during the period of December through May to protect adult salmonid migration and spawning flow needs (City of Santa Cruz 2018). SLVWD's combined diversions from the Felton system (1.6 cfs system maximum capacity; 1.0 cfs maximum historic production) represent less than 4 percent of the City's proposed instream flow commitment and are therefore highly unlikely to affect attainment of the 40 cfs adult salmonid migration and spawning flow needs, especially since such flows would occur during the wet season when water demands on the Felton system decrease. Thus, neither adult salmonid migrations nor the City's ability to exercise its Felton

Diversion water rights are expected to be affected by SLVWD's continued Felton system diversions during the fall, winter, and spring.

While it may be argued that the biological justification for the pre-adult migration season minimum flow requirements in September and October were intended to protect juvenile salmonids rearing in the lower San Lorenzo River, this does not appear to be the case since neither the City's nor SLVWD's water right permits stipulate minimum flow thresholds for the June through August summer rearing period. The City's water right permit does not allow for diversions during that period, thereby negating the need for instream flow requirements. However, SLVWD's water right allows for year-round diversions. The fact that Permit 20123 does not stipulate minimum flow requirements for the San Lorenzo River during the warm, low flow period of June-August, yet does stipulate instream flow requirements starting in September, is further evidence that the intent of including the SLRBT requirement in SLVWD's permit was to harmonize SLVWD's upstream rights with the City's water rights permits in effect at that time, rather than to protect fisheries resources. Moreover, SLVWD's continued compliance with bypass flow requirements on Fall Creek under Scenario 1b ensures that proportionally appropriate contributions of Fall Creek flows to the San Lorenzo River will be maintained during summer and fall baseflow conditions.

Environmental

Implementation of Scenario 1b would not require any construction activities or changes to current operations, and no new impacts to environmental resources would occur. However, proposed changes to existing water right permit terms may require CEQA review.

3.1.5 Water Rights

Under Scenario 1b, SLVWD is proposing to petition the State Water Board to relieve the District of its current requirement specified in Term 13 of water right Permit 20123.

As discussed above, SLVWD's water right permit requirement for minimum bypass flows at SLRBT during the period of September through May were intended to harmonize SLVWD's Permit 20123 with the terms of the City of Santa Cruz's permits in effect at that time. The City recently agreed to bypassing up to 40 cfs at the Felton Diversion during the period of December through May to protect adult salmonid migration and spawning flow needs (City of Santa Cruz 2018) and SLVWD's Felton system diversions amount to less than 4 percent of that flow target. During the period of September-November, the City will continue complying with its existing water right permit terms. However, the City rarely, if ever, exercises its rights during that period. The City operates the Felton Diversion to allow for a flushing flow each fall to scour any debris accumulated during low flow periods and only begins diverting after there have been two flow events, each exceeding 100 cfs (ENTRIX, Inc. 2004, as cited in HES 2012). Since the City already agreed to bypass up to 40 cfs at the Felton Diversion December-May and does not typically exercise its water right during September-November unless flows at SLRBT are significantly higher than the existing permit terms, relieving SLVWD of its permit Term 13, which partially restricts SLVWD's Felton diversions in September-May only, would be unlikely to affect the City's water rights at its Felton Diversion facility.

3.2 Scenario 1f: South System Imports North System Unused Potential Diversions

3.2.1 Description of Scenario

Under Scenario 1f, SLVWD would export unused potential diversions from North system surface water sources to the South system as a substitute for pumping groundwater from the Pasatiempo wells, thereby providing in-lieu recharge of the SMGB. The WAA defines the term "unused potential diversions" as potential diversions within existing water rights and diversion capacities that exceed demand within the service area within which they are diverted, but which potentially could be transferred to another system or used for aquifer storage and recovery (ASR). In other words, existing diversion capacities or rates in the North system would not increase under Scenario 1f. Rather, some water that is currently left in the stream un-diverted because simulated monthly demands in the North system are fully met would be diverted and transferred to the South system via the existing North-South intertie (i.e., Intertie #3). Based on the results of the WAA, an average of 115 afy and a maximum of 300 afy would be transferred to the South system, as needed, to fulfill demand during months (e.g., December through April) when potential diversions exceed North system demand (Exponent 2019).

3.2.2 Operations

SLVWD's existing infrastructure and standard diversion operations would not change under implementation of Scenario 1f. Water diverted from the North system's surface water sources would continue to be delivered via gravity pipeline (Five-Mile Pipeline) to the Lyon Treatment Plant in Boulder Creek, but a portion of the treated water would be transferred to the South system distribution system via Intertie #3. The only material change to SLVWD operations will be the diversion of available water that is currently left in-stream when North system demands are fully met. Pumping of the South system's Pasatiempo wells would be reduced by an equivalent amount. Based on WAA simulations, North system diversions of currently unused flows would occur primarily during the high flow months of December through April, although diversions may extend into May or June in wet water years.

3.2.3 Infrastructure

No infrastructure changes or upgrades are necessary to implement Scenario 1f. SLVWD would continue to use the existing surface water diversion structures, pipelines, and treatment plant. No changes to diversion, delivery, or treatment capacities would need to occur. However, Intertie #3 was constructed in 2015 for the express purpose of enabling intersystem transfers during emergencies and is currently not approved for non-emergency use.

3.2.4 Anticipated Effects

Water Supply

Under Scenario 1f, the South system would import an average and maximum of 115 afy and greater than 300 afy, respectively, as needed to fulfill demand during months when potential diversions exceed North system demand. This would result in an equal reduction in South system groundwater pumping, equivalent to an approximately 32 percent decrease in average annual pumping from the Pasatiempo wells. Groundwater levels at the Pasatiempo wells have declined substantially since the early 1980s, and implementation of Scenario 1f is expected to moderate those declines and contribute toward the regional goal of achieving SMGB sustainability while improving SLVWD water supply sustainability and flexibility.

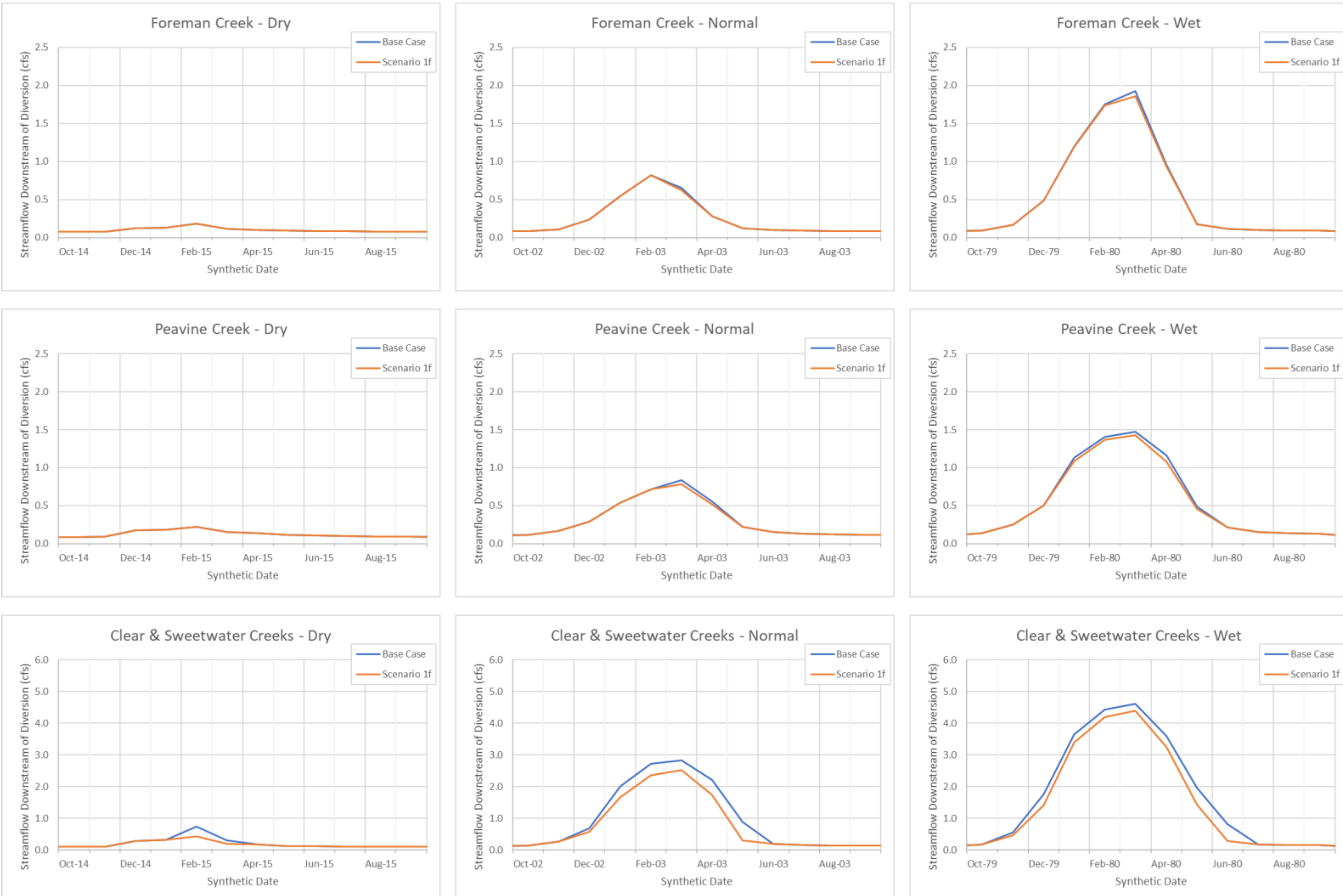
Fisheries

As described in the WAA (Exponent 2019), the percent of simulated average monthly flow remaining downstream of North system diversions with implementation of Scenario 1f would be only slightly less (≤1 percent) than under existing conditions. This is because diversions in excess of North system demand would mostly occur during high streamflow months (December through April) when diversions comprise only a small percentage of unimpaired flows. Approximately 90 percent (104 af) of the average annual unused potential diversions simulated to be transferred to the South system under Scenario 1f would originate from the Clear Creek drainage, including Sweetwater Creek, which is considered a low priority basin for salmonids (Podlech 2019). Diversions from the Boulder Creek tributaries of Peavine and Foreman creeks would only account for approximately 7 percent and 3 percent, respectively, of the water transferred to the South system, accounting for a combined average of 11 af of additional annual wet season diversion from the Boulder Creek subbasin.

Figure 3-1 compares hydrographs of the simulated mean monthly flow remaining downstream of the North system diversions for the base case and Scenario 1f during the representative dry (75 percent exceedance probability), normal (50 percent exceedance probability), and wet (25 percent exceedance probability) water years of 2015, 2003, and 1980, respectively. The simulated hydrographs for Peavine Creek and Foreman Creek show virtually unchanged mean monthly streamflows under Scenario 1f compared to existing base case conditions, and no adverse effects to Boulder Creek flows are therefore expected to occur as a result of the additional diversion of unused potential from those tributary sources.

The largest reduction in streamflow would occur in the Clear Creek drainage during normal and wet years when currently unused potential diversions are highest. However, even during the simulated representative wet water year of 1980 (**Figure 3-1**), the difference in mean monthly streamflow remaining downstream of the Clear Creek and Sweetwater Creek diversions was generally less than 0.3 cfs. Since the capacities of the existing diversions would remain unchanged under Scenario 1f and the diversion of unused potential would only occur during high flow months, the effect of additional diversions on flows in the San Lorenzo River would be negligible under Scenario 1f. For example, of the representative water years depicted in **Figure 3-1**, the largest simulated reduction in average monthly streamflow remaining in Clear Creek after Scenario 1f diversions of currently unused potential occurred in June of wet water year 1980 when an average monthly flow of 0.81 cfs would have remained under existing conditions and 0.29 cfs remained under Scenario 1f (i.e., a 64 percent reduction). The simulated mean monthly streamflow in the San Lorenzo River at the SLRBT gage for the month of June 1980, however, was 51.2 cfs. The reduction of 0.52 cfs in Clear Creek streamflows resulting from Scenario 1f therefore represents an approximately 1 percent reduction in San Lorenzo River flows at that time.

The 32 percent reduction in South system groundwater pumping simulated for Scenario 1f is estimated to increase the percentage of drought baseflow remaining as a result of assumed groundwater pumping effects by 4 percent in Bean Creek at the Zayante Creek confluence, 3 percent in Zayante Creek at the San Lorenzo River confluence, and 1 percent in the San Lorenzo River at SLRBT compared to existing



SOURCE: Exponent (2019);
EKI, unpublished.

Figure 3-1
Simulated Mean Monthly Stream Discharge Remaining Downstream of North System Diversions during a Dry (2015), Average (2003), and Wet (1980) Water Year under Base Case and Scenario 1f Operations

baseline conditions (Exponent 2019). These estimated increases in drought baseflows are modest (approximately 0.1 cfs) but biologically relevant during the most critically low flow years in these tributaries where low summer streamflows are considered a primary factor limiting fish habitat even in non-drought years (Alley et al. 2004).

Overall, the simulated effects of Scenario 1f are expected to result in no discernable impact to high surface flows in anadromous streams such as Boulder Creek and the San Lorenzo River, a meaningful reduction in groundwater pumping promoting in-lieu recharge and SMGB sustainability, and a modest but potentially important increase in minimum drought baseflows in eastern tributary streams.

Environmental

All infrastructure components necessary for implementation of Scenario 1f are existing. No new construction would be required and therefore no construction-related impacts to environmental resources are expected. Implementation of Scenario 1f would result in an increased operation of the Intertie #3 pumps. Potential greenhouse gas (GHG) emissions of the intertie's three pumps (two duty and one standby) were previously analyzed in the final Initial Study/Mitigated Negative Declaration (IS/MND) prepared for the Scotts Valley Multi-Agency Regional Intertie Project (SLVWD 2013). Although the interties constructed for the regional project were intended for emergency use only (i.e., infrequent and intermittent operation), the analysis conservatively assumed that the pumps would operate continuously. Under continuous operation, the Intertie #3 pumps were estimated to produce 294 metric tons of carbon dioxide equivalents (CO_2e) of indirect GHG emissions from electricity use annually (SLVWD 2013). Considering the intermittent use of the pumps under the emergency project (i.e., substantially less than the continuous use estimates), SLVWD determine GHG emissions impacts to be less than significant, but the impact significance of near-continuous use was not determined. Noise impacts of pump operation were determined to be less than significant. Potential impacts of increased use of intertie pumps under the conjunctive use Scenario 1f will need to be evaluated under CEQA.

3.2.5 Water Rights

SLVWD has pre-1914 appropriative rights to divert surface water from sources within its North System, including Peavine, Foreman, Clear,[8] and Sweetwater creeks among others. The maximum amount of water that can be diverted under a pre-1914 appropriative water right, such as these, typically is measured by how much water was diverted and put to reasonable and beneficial use prior to 1914. Total volumes associated with the documented pre-1914 uses of SLVWD's existing North System water rights more than cover SLVWD's current operations. Pre-1914 appropriative surface water rights such as these do not require a permit or license from the State Water Board. The place of use, purpose of use, or point of diversion of these water rights can be changed by the owner without any petition or application to the State Water Board, subject to the "no-injury" rule, Water Code section 1706. Such changes may be documented after

[8] SLVWD currently has an agreement with a downstream water user to allow 30 gpm (0.07 cfs) to bypass its Clear Creek diversion at all times.

their implementation when submitting Supplemental Statements of Water Diversion and Use to the State Water Board.

CHAPTER 4

Phase 2: Long-Term Conjunctive Use Plan Implementation

This chapter describes conjunctive use projects proposed to be implemented in the long-term (i.e., greater than five years). Both Phase 2 projects require construction of new or modified infrastructure. While physical improvements necessary for implementation of one of these projects (Scenario 2b) are sufficiently defined for CEQA analysis, implementation of the other project (Scenario 3d) will require significant additional feasibility and design information.

4.1 Scenario 2b: South System Imports from Loch Lomond for In-Lieu Recharge

4.1.1 Description of Scenario

Under Scenario 2b, SLVWD would utilize its Loch Lomond allotment to deliver stored reservoir water to the South system for in-lieu recharge. Loch Lomond water would be delivered via a new raw water connection between the City of Santa Cruz's Newell Creek pipeline and the Felton system raw water pipeline. After treatment at the Kirby WTP, water would be delivered to the South system via Interties #6 and #3. A direct Felton-South intertie is currently not available or planned for this conjunctive use component. Implementation of this scenario would require new infrastructure, including a new raw water pipeline, and upgrades to existing infrastructure such as modifications to the Kirby WTP in Felton. This conjunctive use component would also utilize the two existing emergency interties on a more frequent, non-emergency basis.

4.1.2 Operations

The Loch Lomond Source Development Study (SPH 2010) recommended blending water from Loch Lomond into the Felton raw water system prior to treatment at the Kirby WTP. To implement Scenario 2b, SLVWD would tie into the City of Santa Cruz's existing raw water pipeline in the vicinity of the Graham Hill pump station, located at the intersection of Graham Hill Road and East Zayante Road in Felton. Treated water would then be transferred from the Kirby WTP to the South system distribution system via the existing Interties #3 and #6.

With the implementation of the Stage 2 Disinfection Byproducts Rule (DBPR), reducing the trihalomethane (THM) formation potential of Loch Lomond raw water is a significant operational constraint for SLVWD under Scenario 2b. Moreover, necessary upgrades to the Kirby WTP to treat Loch Lomond water have the potential to increase the classification of the plant which, in turn, may increase the minimum certification requirements for shift operators and may increase staffing requirements, potentially to 24-hour staffing. The necessary treatment plant upgrades are discussed in detail in the *Loch Lomond Source Development Study* (SPH 2010).

4.1.3 Infrastructure

Interties #3 and #6 were constructed in 2015 for the express purpose of enabling intersystem transfers during emergencies and are currently not approved for regular or continuous use. Environmental review of the expanded, non-emergency use of the interties would need to be conducted for implementation of Scenario 2b. In addition, a new raw water connection between the City of Santa Cruz's Newell Creek pipeline (i.e., Loch Lomond Reservoir to the Graham Hill Treatment Plant pipeline) and the Felton raw water system would need to be constructed. The Kirby WTP is located relatively close to the Newell Creek pipeline. The currently envisioned alignment for the interconnecting pipeline would extend from the Newell Creek pipeline across the San Lorenzo River at San Lorenzo Way in Felton, crossing beneath Highway 9, along Clear View Place to Cooper Street, and along Cooper Street to tie-in to the existing water line at Farmer Street.

According to SPH (2010), the Kirby WTP has the available capacity and necessary infrastructure to accommodate any improvements that may be needed to process additional raw water up to the 313 afy allotment from Loch Lomond Reservoir (SPH 2010). Necessary WTP improvements, such as a new blending tank, are described in detail in the Loch Lomond Source Development study (SPH 2010).

4.1.4 Anticipated Effects

Water Supply

Under Scenario 2b, the South system would import an average of 245 afy, ranging between 120 and 290 afy, from SLVWD's Loch Lomond allotment. The use of Loch Lomond water would result in an equal reduction in South system groundwater pumping, equivalent to a simulated 67 percent reduction in pumping from the Pasatiempo wells. Groundwater levels at the Pasatiempo wells have declined substantially since the early 1980s, and implementation of Scenario 2b is expected to moderate those declines and contribute toward the regional goal of achieving SMGB sustainability while improving SLVWD water supply flexibility, especially when combined with the in-lieu recharge realized under Scenario 1f (i.e., export of North system unused potential diversions to South system).

It should be noted that Scenario 2b, as simulated by Exponent (2019), also incorporates WAA Scenario 2a, the import of an average of 4 afy of Loch Lomond water to the North system and an average of 50 afy to the Felton system to help meet unmet demand in those systems.

Fisheries

The South system's import of Loch Lomond water would result in a simulated 67 percent reduction in groundwater pumping from the Pasatiempo wells. This in turn would result in an estimated 8 percent increase in drought minimum baseflows remaining in Bean Creek at the Zayante Creek confluence, and a 7 percent increase in drought minimum baseflows in Zayante Creek at the San Lorenzo River confluence (Exponent 2019), equivalent to a drought baseflow increase of approximately 0.15 cfs in both streams. The mainstem San Lorenzo River at SLRBT would receive a 3 percent (0.2 cfs) increase in drought baseflow levels.

Water is diverted and stored in Loch Lomond Reservoir under the City of Santa Cruz's water right permits pursuant to applicable terms related to diversion season, maximum diversion rate, and minimum flow requirements for Newell Creek and the San Lorenzo River. The City is in the process of finalizing and implementing a Habitat Conservation Plan (HCP) aimed at avoiding and minimizing effects of its diversions on steelhead and coho salmon, including agreed-upon increases in bypass flows during the adult salmonid migration and spawning season (see Section 3.1.4). SLVWD's allotment of water stored in Loch Lomond therefore represents environmentally "free" water, or water for which the potentially adverse effects of diversion from the San Lorenzo River will have already been avoided or minimized. In other words, no additional adverse effects to streamflows and fisheries habitat would occur if SLVWD were to exercise its Loch Lomond allotment under Scenario 2b. From a fisheries perspective, therefore, Scenario 2b represents an entirely beneficial conjunctive use project.

Moreover, it should be noted that while the estimated increase of approximately 0.15 cfs in minimum drought baseflow levels in Bean and Zayante creeks may be considered modest, the combined implementation of scenarios 1f (i.e., export of North system unused potential diversions to South system) and 2b is estimated to result in a cumulative increase of approximately 0.25 cfs in both creeks during drought baseflow conditions, representing a not-insignificant benefit to fisheries resources in these tributaries during the most stressful juvenile rearing periods.

As described above, Scenario 2b includes the use of an average of 50 afy of Loch Lomond water in the Felton system to meet demand during severe drought events when compliance with the Fall Creek bypass flow requirements may result in result in insufficient yield from Felton sources. As such, Scenario 2b would help ensure minimum flow requirements for salmonids in Fall Creek and cold water contributions to the San Lorenzo River are maintained at permitted levels at all times.

Environmental

Implementation of Scenario 2b requires the construction of a new raw water interconnection between the Newell Creek pipeline and the raw water line leading from the Fall Creek intake to the Kirby WTP. Although the conceptual alignment is located largely within existing roadways, construction-related impacts such as to traffic, noise, water quality, and biological resources will need to be considered in the CEQA analysis.

As with Scenario 1f, implementation of Scenario 2b would result in increased operation of existing intertie pumps. Potential greenhouse gas (GHG) emissions of Interties #3 and #6 were previously analyzed for the final Initial Study/Mitigated Negative Declaration (IS/MND) prepared for the Scotts Valley Multi-Agency Regional Intertie Project (SLVWD 2013). Although the interties constructed under this project were intended for emergency use only (i.e., infrequent and intermittent operation), the analysis conservatively assumed that the pumps would operate continuously. Under continuous operation, Intertie #3 and #6 pumps were estimated to produce 294 metric tons of CO_2e per year each as a result of indirect GHG emissions from electricity use annually each (SLVWD 2013), or a combined 588 metric tons annually. Considering the intermittent use of the pumps under the emergency project (i.e., substantially less than the continuous use estimates), SLVWD (2013) determined GHG emissions impacts to be less than significant, but the impact significance of more regular seasonal use was not determined. Noise impacts of intertie pump operation were also determined to be less than significant. Potential impacts of increased use of intertie pumps under the conjunctive use Scenario 2b will be evaluated under CEQA.

4.1.5 Water Rights

As described in more detail in Sections 1.3.1 and 3.1.4, SLVWD has an allotment to water stored in the Loch Lomond reservoir and this water is diverted and stored by the City of Santa Cruz in accordance with its water rights permits and HCP commitments. In 2018, the City prepared an Initial Study (IS) and issued a Notice of Preparation (NOP) to prepare an Environmental Impact Report (EIR) for the Santa Cruz Water Rights Project. The proposed project involves modification of existing City water rights to increase the flexibility of the water system by improving the City's ability to utilize surface water within existing allocations. One of the project components is to expand the currently authorized Places of Use (POUs) of City water rights to ensure they are consistent and include the service areas of potential partnering regional water districts, including SLVWD. However, the proposed change in the POUs of the City's rights is not necessary to authorize the transfer of Loch Lomond water to SLVWD's South system proposed under Scenario 2b of this conjunctive use plan The City's existing State Water Board license for the Loch Lomond Reservoir allows the City to provide SLVWD with its allotment for use SLVWD for use anywhere in the San Lorenzo Basin, including Upper San Lorenzo Valley and the South system.

4.2 Scenario 3d: North System Operates ASR Project Using North and Felton System Unused Potential Diversions, and Reduces Baseflow Diversions from North System

4.2.1 Description of Scenario

SLVWD lacks significant water storage infrastructure, such as reservoirs, and therefore currently lacks the ability to increase surface water diversions during the high flow winter and spring seasons for storage and subsequent use during the low-flow summer and fall periods. Groundwater levels at the South system's Pasatiempo wells have declined substantially since the early 1980s, and the North system's Olympia wells have exhibited a slight long-term downward trend as well, suggesting that higher rates of extraction may be unsustainable without augmenting recharge (Exponent 2019). SLVWD's 313 afy Loch Lomond allotment provides an available source of stored water but does not provide additional capacity to SLVWD for further storage. Conjunctively using the Loch Lomond allotment to supply South system demand and promote in-lieu groundwater recharge (i.e., Scenario 2b discussed above) is expected to enhance groundwater sustainability and drought baseflow levels in important fisheries tributaries. However, SLVWD's ability to reduce summer surface water diversion rates in the North and/or Felton systems for fisheries habitat enhancement is currently constrained by a lack of available water storage infrastructure.

Exponent (2019) analyzed three conjunctive use scenarios (3a through 3c) that would increase storage in, and yield from, the Olympia wellfield in the North System through operation of a hypothetical aquifer storage and recovery (ASR) project supplied by available surface water in excess of monthly water demand during wet flow season (December through May) from either the North system (Scenario 3a), or the Felton system (Scenario 3b), or both (Scenario 3c). As analyzed in the WAA, all three scenarios assumed that the yield from such an ASR project would be used to offset groundwater pumping from the North system (Olympia and Quail Hollow wells), thereby increasing drought minimum baseflows in lower Newell, Zayante, and Bean creeks by up to 33 percent (Exponent 2019). It is important to note that scenarios 3a through 3c all incorporate Scenario 2b (South System Imports from Loch Lomond for In-Lieu Recharge) proposed for Phase 2 implementation and discussed above in Section 4.1 above.

Upon review of scenarios 3a through 3c analyzed in the original WAA (Exponent 2019), a fourth ASR scenario was identified (Podlech 2019), analyzed (Johnson 2019), and selected by SLVWD for inclusion in this conjunctive use plan. Under Scenario 3d, SLVWD would utilize a portion of the estimated Scenario 3c ASR extraction volume to reduce or temporarily forego summer surface water diversions from the North system, specifically Peavine and Foreman creeks, for fisheries benefits in Boulder Creek and the middle San Lorenzo River reach. While using a portion of the simulated ASR water supply as substitute for summer surface diversions rather than applying all of it to reducing groundwater water pumping rates would slightly reduce the WAA-estimated drought baseflow benefits to Newell, Zayante, and Bean creeks, the direct benefits to Boulder Creek, estimated at over 1 cfs in some years, as well as to the middle San Lorenzo River, outweigh the slight reduction in benefits to Newell, Zayante, and Bean creeks. In other words, Scenario 3d would distribute the potential benefits of ASR to fisheries habitat throughout a larger portion of the watershed than WAA-envisioned ASR scenarios 3a through 3c.

4.2.2 Operations

The implementation of an effective ASR project requires considerable planning such as feasibility analyses (including application of a groundwater model), site-specific injection capacity and geochemical analyses, and implementation of a pilot project to assess probable system performance, cost, and schedule to complete build out of the full ASR system. These planning efforts have not been initiated and the operational details of Scenario 3d are unknown at this time. Conceptually, however, SLVWD would divert available water from the North and Felton systems that is currently left in-stream when demands for those systems are fully met during the wet season. Based on the WAA (Exponent 2019) and Johnson (2019) simulations, North and Felton system diversions of currently unused flows would occur primarily during the high flow months of December through April.

After treatment at the North and Felton WTPs, water would be transferred to new injection well(s) in the Olympia Well field. Additional disinfection and organic carbon removal of injection water will likely be necessary. Presumably, additional treatment would occur at a new dedicated ASR treatment facility constructed near the injection site(s) rather than upgrading the Lyons and Kirby plants. New operational and water quality monitoring plans for both injection and extraction would need to be developed. Depending on the results of necessary site-specific investigations, ASR extraction would occur either via existing Olympia wells or new dedicated extraction wells.

4.2.3 Infrastructure

The new infrastructure needs for Scenario 3d would be significant. In addition to ASR injection (and potentially extraction) wells, a dedicated disinfection facility would likely need to be constructed. Depending on final ASR facility sighting, additional pipelines connecting the system to the existing North system lines will be needed. Water supplied from Felton system unused potential diversions would be transferred to the North system via existing Intertie #6. Although the intertie can currently only be used for emergencies, it is assumed that implementation of Scenario 2b (Section 4.1) would occur prior to implementation of Scenario 3d and that intertie would therefore already be authorized for conjunctive use.

Prior to full build-out of Scenario 3d, a pilot project ASR system would likely be developed and constructed. Such a pilot project would be subject to environmental review under CEQA.

4.2.4 Anticipated Effects

Water Supply

For all Scenario 3 alternatives, Exponent (2019) assumed an ASR injection capacity of 400 gpm from December through May, extraction capacities ranging from 250 to 585 gpm from June through November, and a 100 percent extraction efficiency. As simulated under optimal conditions, SLVWD would divert an average of 190 afy and 220 afy of currently unused potential diversions from the North and Felton systems, respectively, for ASR injection and subsequent extraction. The simulated June through November extraction period would allow SLVWD to reduce North system groundwater pumping by an estimated 53 percent. Implementation of this conjunctive use project would provide SLVWD with increased water supply flexibility. For modelling purposes, Exponent (2019) and Johnson (2019) assumed that yearly ASR injection and extraction rates would be the same (i.e., all water injected in December through May would be extracted the subsequent June through November). In practice, however, it is likely that injections would exceed extraction in wet water years, effectively allowing SLVWD to bank water in the aquifer for dry water years when extractions would presumably exceed injections.

It should be noted that Scenario 3d, as simulated and analyzed by Johnson (2019), incorporates implementation of Scenario 2b, which includes the import of an average of 50 afy of Loch Lomond water to the Felton system to help meet the unmet system demand that would occur under full compliance with existing Felton water right terms. In practice, ASR extractions could potentially be used to meet Felton demand under Scenario 3d instead of Loch Lomond allotment, but the water supply and drought baseflow effects of this approach have not been analyzed yet.

It should also be noted that for modelling simplicity, Johnson (2019) analyzed the water supply implications of Scenario 3d with the assumption that SLVWD would entirely forego diversions from Peavine and Foreman creeks during the period of July through September. However, as described in the fisheries analysis (Podlech 2019), summer diversions from these two sources could be managed in a more nuanced manner based on ambient Boulder Creek streamflow levels, especially during above-average water years. Using a portion of injected ASR water to reduce Peavine and Foreman Creek diversion when Boulder Creek flow drops below approximately 2.5 cfs, and foregoing those diversions entirely when Boulder Creek flows drops to approximately 1.5 cfs, would be expected to significantly enhance baseflow rearing conditions for juvenile steelhead and other native fish in Boulder Creek while preserving ASR storage when streamflows in Boulder Creek are high enough to support steelhead rearing in Boulder Creek during the July through September extraction period.

Fisheries

Under Scenario 3d, the injection and recovery of currently unused potential North and Felton systems diversions in an ASR project would be used to offset the amount of groundwater otherwise withdrawn at the Olympia wells to meet North system summer demand and to offset reductions in summer surface water diversions from the North system, specifically Peavine and Foreman creeks, for fisheries benefits in Boulder Creek and the middle San Lorenzo River reach.

Johnson (2019) analyzed the water supply implications of Scenario 3d assuming SLVWD would entirely forego from Peavine and Foreman creeks during the period of July through September. Under such a scenario, the ASR injection and subsequent extraction of an average of 417 afy would reduce North system groundwater pumping by an estimated 53 percent. Combined with the 68 percent reduction in South system pumping due to Loch Lomond imports (Scenario 2b above), Scenario 3d would increase drought minimum baseflows in lower Newell, Zayante, and Bean creeks by an estimated 12 to 30 percent compared to existing conditions (Johnson 2019). These estimated drought baseflow increases are equivalent to approximately 0.22 cfs in Bean Creek at the Zayante Creek confluence, 0.32 cfs in Zayante Creek at the San Lorenzo River confluence, and 0.53 cfs in the San Lorenzo River at SLRBT, and therefore represent potentially significant enhancements to instream flows during the most critical periods.

Exponent (2019) note that diversions of unused potential from the North and Felton systems system for ASR injection would occur during wet periods and are not expected to lower minimum monthly flows remaining downstream of the diversions during baseflow conditions. Based on the Johnson (2019) simulation, an average of 190 afy of currently unused potential diversion would be diverted from the North system, representing an approximately 65 percent increase over the simulated average unused potential diversion of 115 afy under Scenario 1f (South System Imports North System Unused Potential Diversions) described in Section 3.2.

Figure 4-1 compares hydrographs of the simulated mean monthly flow remaining downstream of the North system diversions for the base case and Scenario 3d during the representative dry (75 percent exceedance probability), normal (50 percent exceedance probability), and wet (25 percent exceedance probability) water years of 2015, 2003, and 1980, respectively. Similar to Scenario 1f (Figure 3-1), the simulated hydrographs for Peavine Creek and Foreman Creek (**Figure 4-1)** show virtually unchanged mean monthly streamflows during the wet seasons of dry and normal water years under Scenario 3d, and only minor (0.25 cfs) flow decreases in a representative wet year. No adverse effects to Boulder Creek flows are therefore expected to occur as a result of the additional diversion of unused potential from those tributary sources.

Conversely, summer baseflows are simulated to increase significantly with combined simulated increases of up to 0.25 cfs in dry years, 0.50 cfs in normal years, and 0.75 cfs in wet years (**Figure 4-1)**, and these increases are expected to help raise summer baseflows in Boulder Creek and the middle San Lorenzo River by similar amounts. It should be noted that **Figure 4-1** depicts simulated Peavine and Foreman flows decreasing to base case levels through the spring before sharply increasing in July due to the fact that the WAA simulations applied a strict July 1 shut-off for surface water diversions from these two drainages. As suggested above, an ambient hydrology-based approach to decreasing diversions from

Peavine and Forman creeks would help provide a more normative hydrologic regime than the date-driven diversion management approach used in the water supply simulation.

The effects of diverting currently unused stream diversions from the Felton system under Scenario 3d are depicted in **Figure 4-2**. Simulated streamflows downstream of the Fall and Bennett creeks diversions would be largely unchanged with a decrease of up to 0.5 cfs (approximately 2 percent) in average monthly winter flows of a representative wet year. Due to lower average winter flows in Bull Creek, the relative reduction in wet year winter flows would be more significant in Bull Creek where a decrease of up to 0.25 cfs represents approximately 25 percent of the simulated average monthly flow under the base case scenario. However, as discussed in the fisheries assessment (Podlech 2019), Bull Creek is not considered a priority stream for steelhead and coho salmon.

Note that the increases in summer baseflows in Bull Creek compared to the base case scenario depicted in **Figure 4-2** are a function of the incorporation of Scenario 2b (Section 4.1), which was simulated to use a portion of the available Loch Lomond allotment to offset the Felton system's demand shortfall under a full water rights compliance scenario.

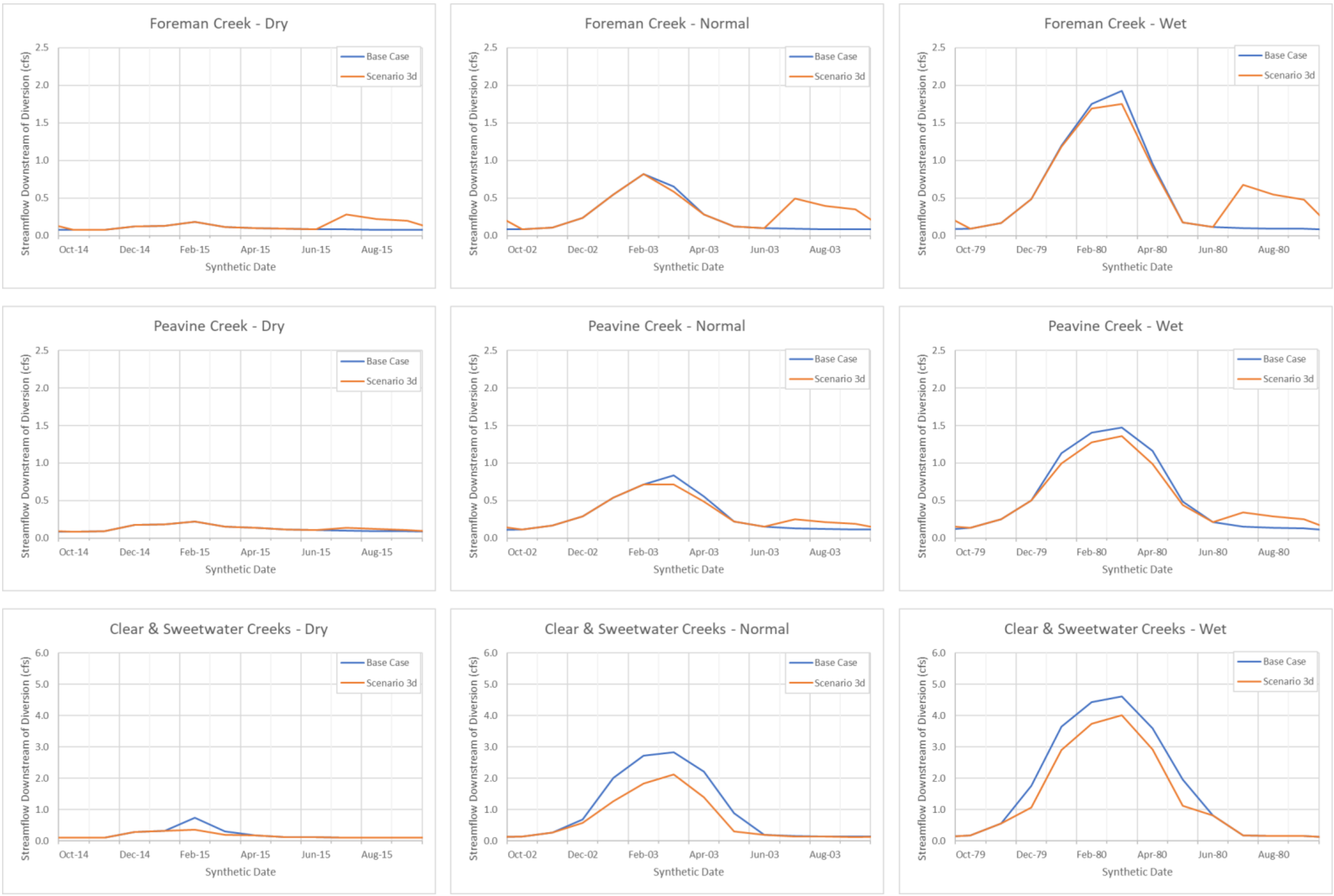
Environmental

Project-level details for the construction and operation of Scenario 3d are not known at this time and the potential for impacts to environmental resources are therefore largely speculative. Based on similar projects, however, implementation of Scenario 3d could potentially result in impacts in the following resources/issue areas:

- Biological resources due to permanent or construction-related disturbance to habitat areas or direct impacts to plants or wildlife species;
- Water quality and hydrology due to changes in groundwater flows and quality and temporary disturbances to soils resulting in changes to water quality in surface water bodies during construction;
- Geology and soils due to incompatible or unstable soil properties, seismicity/faulting, and erosion;
- Cultural resources due to disturbance to known or unknown resources that may be discovered during ground-disturbing activities; and
- Air quality and increased GHG emissions due to higher energy demands (i.e., electricity for pumping).

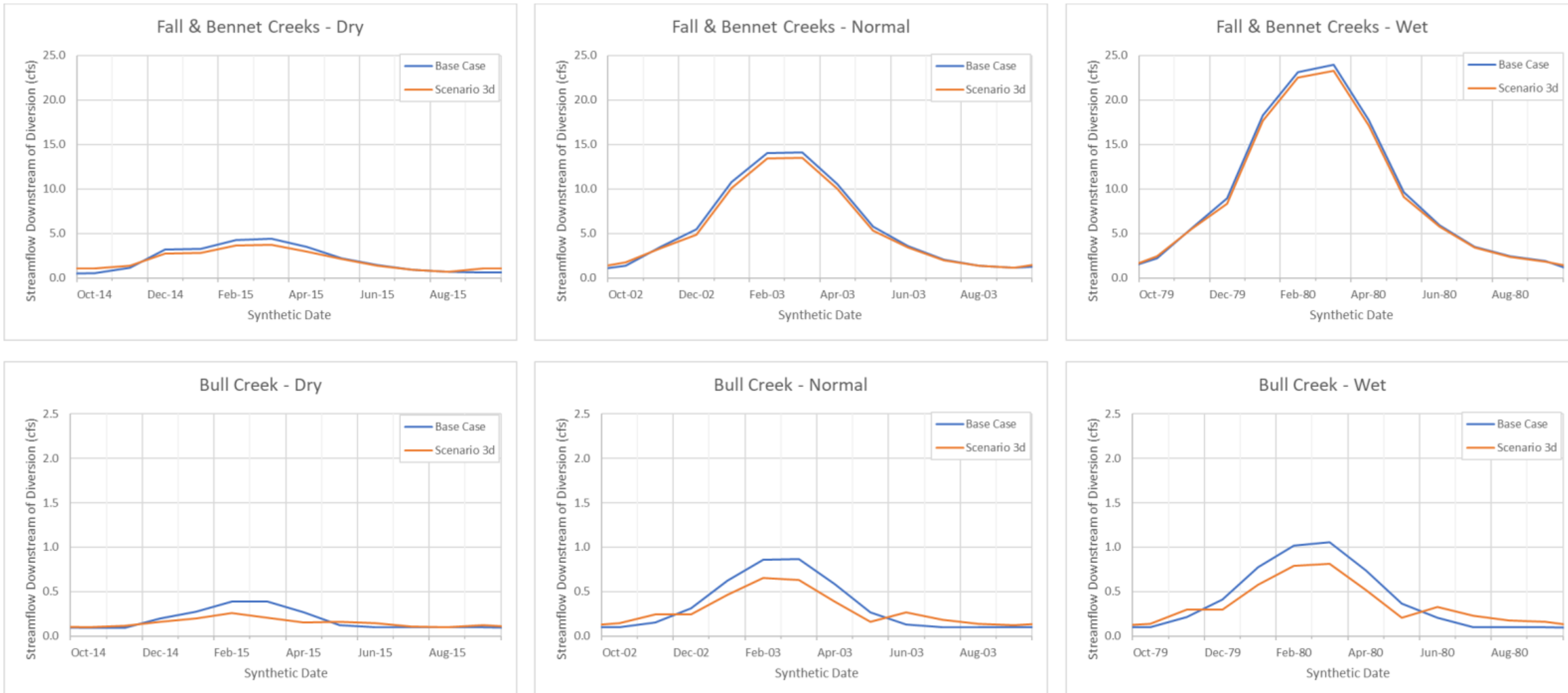
4.2.1 Water Rights

To implement Scenario 3d using surface water diversions from the Felton system, SLVWD would need to petition the State Water Board to add the North system as a place of use to the existing Felton water rights. Water rights petitions would not be necessary for implementation of the scenario using potential diversions within existing North system water rights (see Section 3.2.5) or using SLVWD's Loch Lomond allotment (see Section 4.1.5).



SOURCE: Exponent (2019); Johnson (2019); EKI, unpublished.

Figure 4-1
Simulated Mean Monthly Stream Discharge Remaining Downstream of North System Diversions during a Dry (2015), Average (2003), and Wet (1980) Water Year under Base Case and Scenario 3d Operations



SOURCE: Exponent (2019), Johnson (2019); EKI, unpublished.

Figure 4-2

Simulated Mean Monthly Stream Discharge Remaining Downstream of Felton System Diversions during a Dry (2015), Average (2003), and Wet (1980) Water Year under Base Case and Scenario 3d Operations

CHAPTER 5
Summary

SLVWD and the County of Santa Cruz evaluated a total of 23 potential conjunctive use scenarios for opportunities to improve the reliability of surface- and groundwater supplies for the District through conjunctively managing its water supplies while also increasing stream baseflows for fish in the San Lorenzo River watershed. A water availability analysis of these scenarios concluded that existing emergency interties combined with potential supplemental water supplies provide SLVWD with significant options and flexibility for increasing conjunctive use and improving stream baseflows. A subsequent fisheries considerations analysis concluded that the four scenarios selected by SLVWD for potential implementation under a conjunctive use program would provide basin-wide improvements to fisheries resources, including increased summer baseflows in Boulder, Fall, Bean, and Zayante creeks and, by extension the mainstem San Lorenzo River, as well as reduced pumping and increased sustainability of groundwater sources of the SMGB. If fully implemented, this combination of conjunctive use projects would also enable SLVWD to fully comply with modified Felton system water right terms.

Implementation of SLVWD-selected Scenario 1b would allow the District to come into full compliance with its Felton system water right permit while allocating conjunctively managed supplies for greater fisheries benefits than the existing priority-based San Lorenzo River minimum flow restrictions. Scenarios 1f and 2b would use currently unused potential diversions during high flow winter and spring conditions and an unused Loch Lomond Reservoir allotment, respectively, for in-lieu groundwater recharge in the South System to increase groundwater aquifer sustainability and drought baseflows in tributary and mainstem reaches of the San Lorenzo River watershed. Scenario 3d would implement an ASR project supplied by unused potential winter and spring diversions from the North and Felton systems for groundwater sustainability, decreased summer surface water diversions, and increased drought baseflows.

Scenarios 1b and 1f do not require any new infrastructure and can be implanted as soon as relevant authorizations are granted. Scenario 2b requires moderate infrastructure improvements (i.e., new pipeline and treatment plant upgrades). Scenario 3d, on the other hand, will require significant additional feasibility investigations, planning, infrastructure, and permitting to implement.

CHAPTER 6
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